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WAR DEPARTMENT TECHNICAL MANUAL

US Army Military History Institute

ORDNANCE MAINTENANCE

VACUUM BRAKE SYSTEMS (BENDIX B-K)

WAR DEPARTMENT

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(For explanation of symbols, see FM 21-6)

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**ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)**

CHAPTER 1

INTRODUCTION

1. SCOPE.

a. The instructions contained in this manual are for the information and guidance of personnel charged with the maintenance and repair of units composing the B-K vacuum power brake system. It deals directly with the bench overhaul of units after they have been removed from the vehicle. This manual does not contain information which is intended primarily for the using arms, since such information is available to ordnance maintenance personnel in 100-series TMs and in FMs.

b. This manual contains description and procedure for disassembly, inspection, repair, rebuilding, test and adjustment of each individual unit.

2. ARRANGEMENT.

a. Chapters 1 and 2 contain introductory material, including explanation of the power brake principle. Chapters 3 through 20 contain maintenance procedures for specific units. Each unit or assembly is covered by a separate chapter.

CHAPTER 2

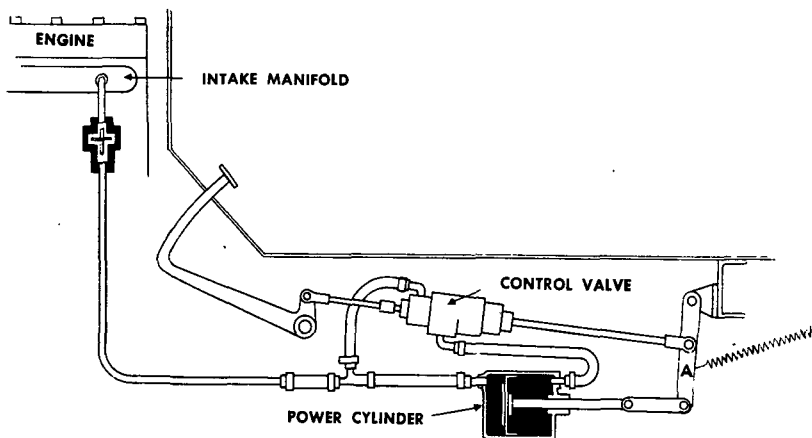
PRINCIPLE OF VACUUM POWER BRAKES

3. PURPOSE.

a. Vacuum brakes are actuating devices designed to create a force to apply the brakes of a vehicle in excess of that practical through physical effort.

4. OPERATING PRINCIPLE.

a. **Vacuum Suspended System.** The principles of vacuum brakes are the pressure differentials of atmosphere or air. Any object at sea level is normally subject to an outside air pressure of almost 15 pounds per square inch of its surface; inside and outside; top, bottom, and sides. This pressure is termed "atmospheric pressure" and



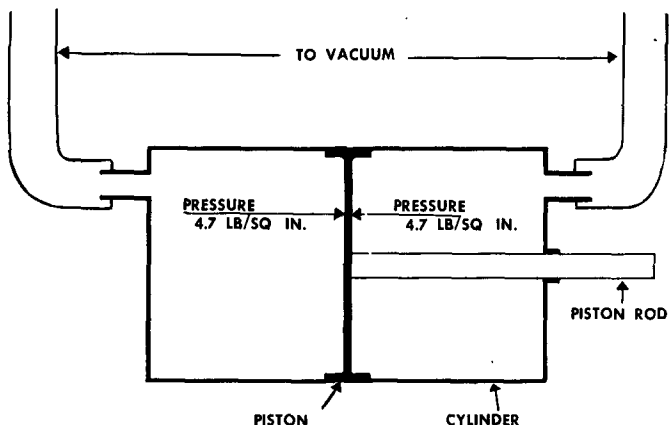
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Figure 1—Power Brake System—Schematic Diagram

is sometimes known as the weight of air. To clarify the principle, analyze the action of vacuum and atmospheric pressure on a piston in a cylinder (fig. 2). If both ends of the cylinder are connected to the intake manifold of a gasoline engine, approximately two-thirds of the air or atmosphere will be drawn into the intake manifold, creating a vacuum of 20 inches on both sides of piston. Piston is now balanced between opposite and equal pressures. By disconnecting the vacuum line at one end of cylinder (fig. 3), and maintaining the vacuum on the opposite end, atmosphere will enter the opened end of cylinder, depleting the vacuum, therein causing an unbalancing of opposite forces. The full weight of air (14.7 pounds per square inch) will then be opposed by only 4.7 pounds per square inch, and piston will move toward the lower pressure side. The differential be-

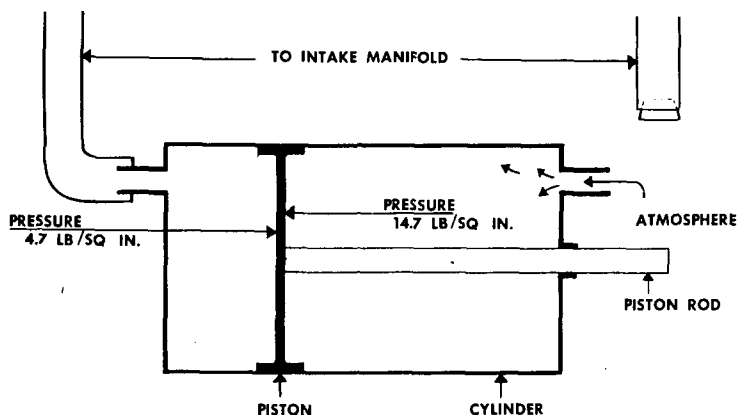
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tween 14.7 pounds and 4.7 pounds is 10 pounds; thus 10 pounds of effort is available for each square inch area of piston. The piston when connected to mechanical levers or hydraulic piston will transmit its power to the brake system. The admittance of air to deplete the vacuum on one side of the piston is metered by a control valve



RA PD 312233

Figure 2—Piston in Cylinder Balanced in Vacuum



RA PD 312234

Figure 3—Piston in Cylinder Actuated by Atmosphere

PRINCIPLE OF VACUUM POWER BRAKES

(fig. 1). The control valve is connected to the section of cylinder where it is desired to admit air. The control valve, when in the released position, is opened between both of its connections; when engine starts, air is drawn from the entire system, balancing the vacuum piston of cylinder in vacuum (fig. 1). Movement of the foot pedal actuates the control valve, metering air to one side of cylinder, thus forcing piston toward vacuum side and applying the brakes. Release of foot pedal reconnects the power cylinder to the intake manifold and the air that had been admitted to power cylinder is withdrawn into the intake manifold, again balancing the vacuum piston in vacuum, allowing the brakes to return to the off position.

b. Atmospheric Suspended System. The principles of this system are identical with those of the foregoing system, but the operation is the opposite. This system starts with cylinder piston balanced in atmosphere, and is actuated by a vacuum being created, rather than a vacuum being depleted. This type system is usually used on a trailer axle and is actuated by a conversion valve which converts from a vacuum system into an air suspended system.

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CHAPTER 3

HYDROVAC—FIRST SERIES

Section I

DESCRIPTION, OPERATION, AND DATA

5. DESCRIPTION.

a. Hydrovac is a trade name for a B-K one-unit vacuum power braking system. It combines into one compact assembly a hydraulically actuated control valve, a tandem piston vacuum power cylinder, and a hydraulic slave cylinder (fig. 4). It is connected hydraulically to both the wheel brakes and the master cylinder, eliminating the need for cross shafts and external levers. The object of the Hydrovac is to multiply the force exerted on the foot pedal, thereby transmitting a greater force to the wheel cylinders.

6. OPERATION.

a. Released (fig. 5). When engine is started, a vacuum is created in Hydrovac compartments Nos. 1, 2, 3, and 4, suspending both vacuum pistons in a balanced vacuum. Piston return spring holds pistons in the off position and piston push rod, being clear of check valve in slave cylinder, permits a direct hydraulic opening from master cylinder to wheel brakes. Control valve diaphragm has like vacuums on each side and is held in the off position by the diaphragm return spring. When the vacuum in the Hydrovac is the same as the source vacuum, the poppet valve in check valve rests on its seat and, in the event of motor failure or rapid acceleration, traps the vacuum in the Hydrovac in readiness for application of brakes.

b. Applied (fig. 6). As the foot pedal is depressed, fluid is forced from the master cylinder into the slave cylinder, through slave cylinder check valve and into wheel brakes; also this fluid reaches the hydraulic adapter of control valve, gradually forcing diaphragm (against tension of return spring) toward the applied position. Diaphragm movement actuates linkage closing vacuum valve, sealing off vacuum from intake manifold. After vacuum valve reaches its seat, the atmospheric valve leaves its seat, permitting air from the air cleaner to enter compartment No. 1, thence through hollow piston rod into compartment No. 3, depleting the vacuum in both compartments. With a high vacuum still present on the rear of the vacuum pistons (compartments Nos. 2 and 4), atmospheric pressure on front ends (compartments Nos. 1 and 3), the pistons travel toward the slave cylinder, closing off the slave cylinder check valve and moving slave cylinder piston, forcing fluid under high pressure into the brake wheels. Manual effort from the master cylinder acts on the rear of slave cylinder piston, assisting the vacuum pistons; thus, the pressure

HYDROVAC—FIRST SERIES

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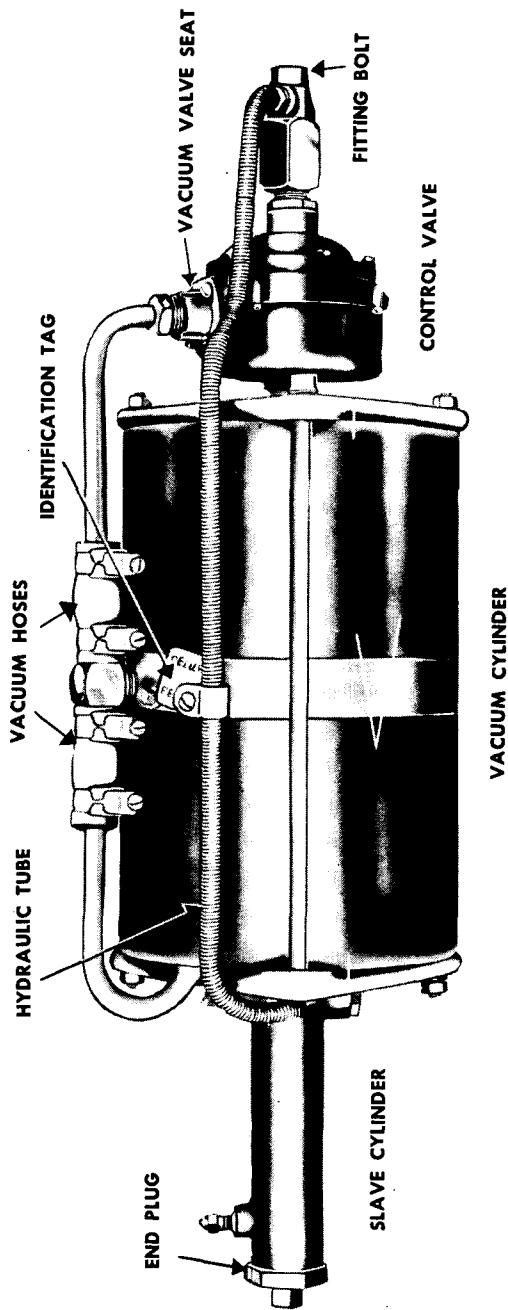
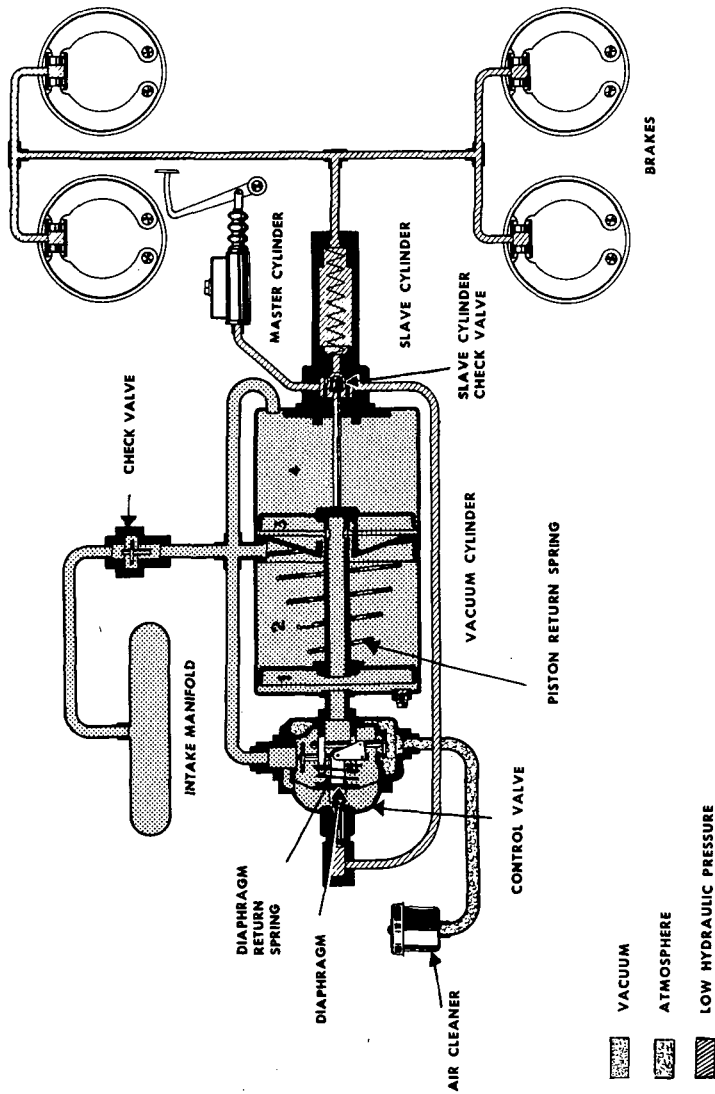


Figure 4—Hydrovac—First Series

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Figure 5—Diagrammatic Hydrovac System—Released

HYDROVAC—FIRST SERIES

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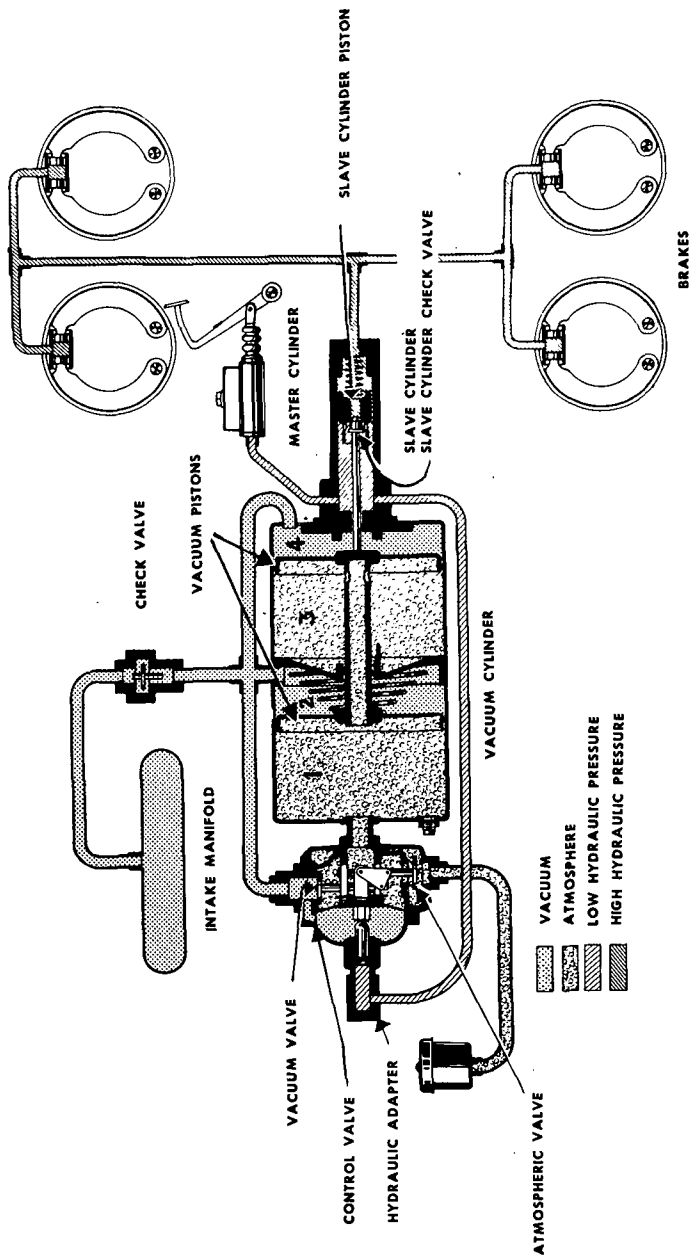


Figure 6—Diagrammatic Hydrovac System—Applied

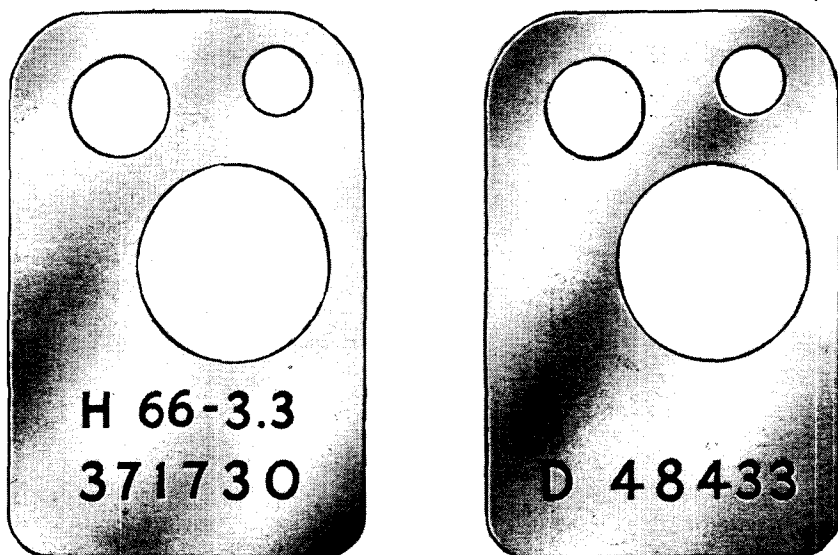
**ORDNANCE MAINTENANCE
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at the wheels is the sum of the output of the vacuum pistons and the pressure from manual effort at the master cylinder. Release of foot pedal pressure allows diaphragm in control valve to return to released position, at which time the Hydrovac returns to the off position.

c. **Partial Application.** When the foot pedal movement stops at any point between released and applied positions, the diaphragm in control valve will hold vacuum and atmospheric valves to their respective seats, holding vacuum pistons at the position attained when foot-pedal movement ceased.

7. IDENTIFICATION DATA.

a. **Identification Tags** (fig. 7). Manufacturers' identification tags showing model and number should be supplemented by an identifica-



RA PD 312238

Figure 7—Identification Tags

tion tag attached to the unit by the using arm or organization forwarding the unit for repair. **NOTE:** *Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for installation on a similar vehicle.*

b. The following table is supplied to assist in identification of models and determining the repair kit to be used in repair of the unit.

HYDROVAC—FIRST SERIES

Bendix Number	Ordnance Number	Model Number	REPAIR KITS	
			Bendix No.	Ordnance No.
371730	D-48433	H-66-3.3	373381	A-303369
372290	D-72387	H-66-3.3	373381	A-303369
373380	.....	H-66-3.3	373381	A-303369
372428	D-72386	H-76-4	373383	A-303370

Code or Model No.	Translation of Model No.
H-66-3.3	Hydrovac— $6\frac{3}{4}$ -inch diameter— $3\frac{3}{8}$ -inch stroke
H-76-4	Hydrovac— $7\frac{3}{4}$ -inch diameter—4-inch stroke

NOTE: "Diameter" in above translation of code number refers to inside diameter of the vacuum cylinder. "Stroke" is the travel of the pistons.

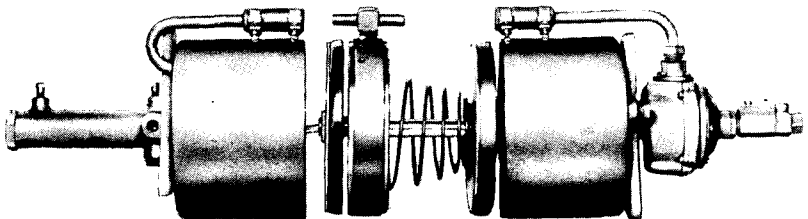
Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

8. DISASSEMBLY.

a. Preliminary Instructions.

- (1) CLEAN UNIT. Wash all external surfaces.
- (2) MARK POSITION OF PARTS (fig. 4). Scribe a line on both cylinder shells and center plate, on control valve, mounting bracket, and on slave cylinder and other mounting bracket. NOTE: *These lines must match to assure correct assembly.*
- (3) REMOVE IDENTIFICATION TAG (fig. 4). Loosen, but do not remove, the end plug in the hydraulic slave cylinder. Remove clip which holds hydraulic tube assembly at center plate, and remove



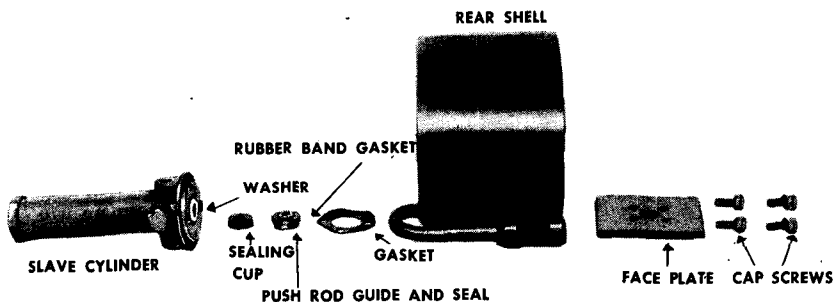
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Figure 8—Cylinder Shells Separated

ORDNANCE MAINTENANCE **VACUUM BRAKE SYSTEMS (BENDIX B-K)**

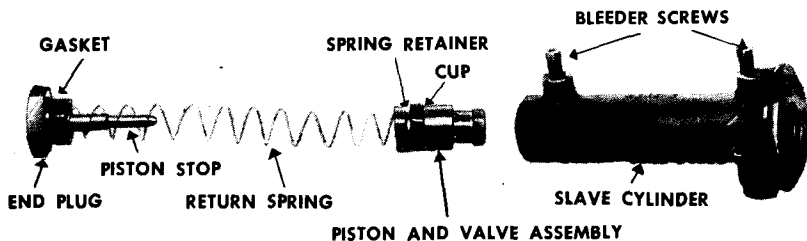
identification tag. **NOTE:** *The identification tag identifies the Hydrovac by a Bendix part number, and facilitates ordering of the proper parts repair kit (par. 7).*

b. Separate Cylinder Shells. Remove the hydraulic tube assembly which connects to the control valve and the hydraulic slave cylinder (fig. 4). Remove the cylinder studs which hold the cylinder shells and center plate together. Loosen the hose clamps. Slide hoses on tubing until they clear the T-fitting. **CAUTION:** *Avoid damaging hose.* Separate the cylinder shells from the center plate (fig. 8). **NOTE:** *Tap with rawhide mallet or handle of hammer if parts stick together. Hold the unit over a pan to catch any oil.*



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Figure 9—Slave Cylinder Removed from Rear Cylinder Shell (Seal Parts Removed)



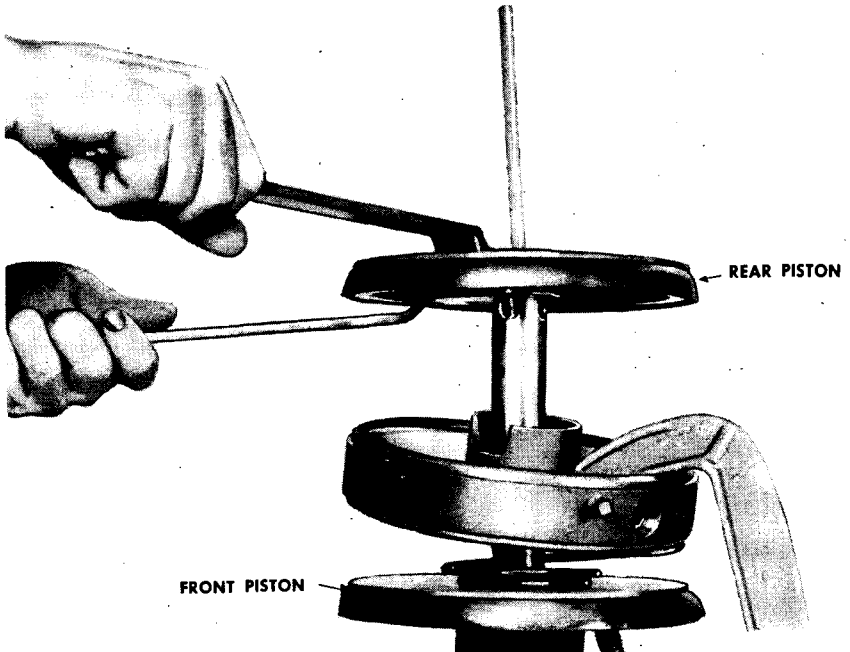
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Figure 10—Slave Cylinder with Internal Parts Removed

c. Remove Slave Cylinder from Rear Cylinder Shell (fig. 9). Remove the four cap screws and lock washers holding the hydraulic slave cylinder, gasket, and face plate to the rear cylinder shell. Remove the push rod guide and seal assembly, the sealing cup, and washer from the slave cylinder bore. **NOTE:** *The lock ring in the slave cylinder bore need not be removed.*

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d. **Disassemble Slave Cylinder** (fig. 10). Remove the end plug and metal gasket from slave cylinder. **CAUTION: A long return spring is held compressed by the end plug; therefore, disassemble carefully.** Remove the hydraulic piston stop, long return spring, spring retainer, piston cup, and the piston and valve assembly from the slave cylinder. Remove the bleeder screws.



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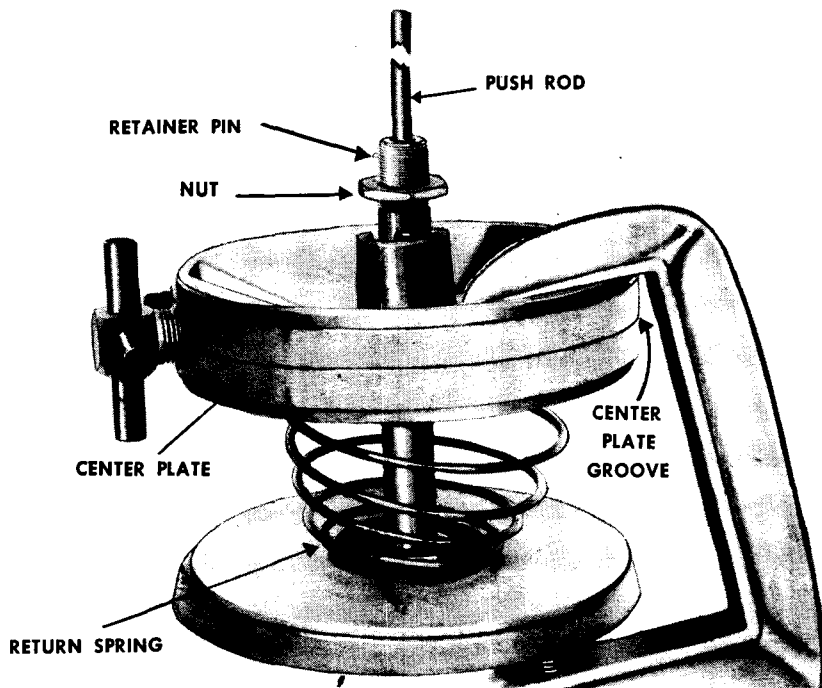
Figure 11—Removing Rear Piston**e. Remove Vacuum Pistons from Piston Rod.**

(1) **REMOVE REAR PISTON** (fig. 11). Place vacuum piston assembly in vise with piston rod up. Compress power cylinder piston return spring with center plate, and hold in compressed position by clamping center plate to front piston, using a C-clamp with thumb screw end of clamp down. Using two wrenches, remove nut from piston rod. Remove rear piston assembly from piston rod.

(2) **REMOVE FRONT PISTON AND SPRING** (fig. 12). Remove the piston push rod from the end of the piston rod by slipping the retainer pin out of the hole in threaded end of piston rod. Remove other nut from upper end of piston rod. Push center plate down against piston and remove C-clamp which is holding the spring compressed. Carefully remove center plate and spring from piston rod. Loosen bottom nut on piston rod by placing wrench on upper nut and turning wrench and piston together. Screw piston rod out of nut. Remove piston assembly from rod, and nut from vise.

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f. Remove Control Valve from Front Shell (fig. 13). Place hydraulic adapter in vise with cylinder shell up. Remove the four screws and lock washers which hold the vacuum valve seat and vacuum tube to the control valve (fig. 4), and remove the seat and tube assembly. Unscrew the cylinder shell from the control valve (fig. 13). Loosen hydraulic adapter body lock nut at boss of control valve cover. Unscrew control valve from hydraulic adapter.



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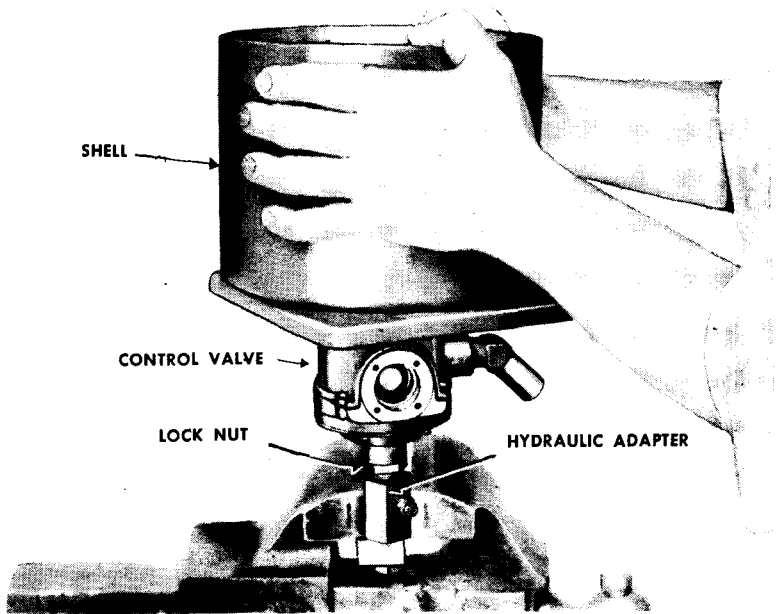
Figure 12—Removing Push Rod

g. **Disassemble Hydraulic Adapter** (fig. 14). Place hydraulic adapter horizontally in vise. Unscrew hydraulic line fitting bolt and remove bolt, fitting, and gaskets. Remove the piston stop and piston with cup from hydraulic adapter cylinder. Remove bleeder screw from side of adapter body.

h. **Disassemble Control Valve** (fig. 15).

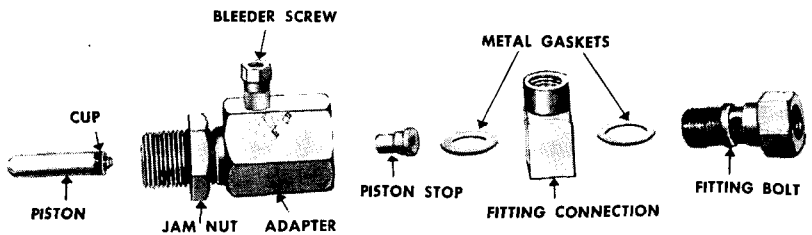
(1) Remove six screws and lock washers which attach control valve cover and spacer to control valve and remove cover, spacer, and gaskets (A, fig. 15).

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Figure 13—Removing Control Valve



RA PD 312245

Figure 14—Hydraulic Adapter—Partially Disassembled

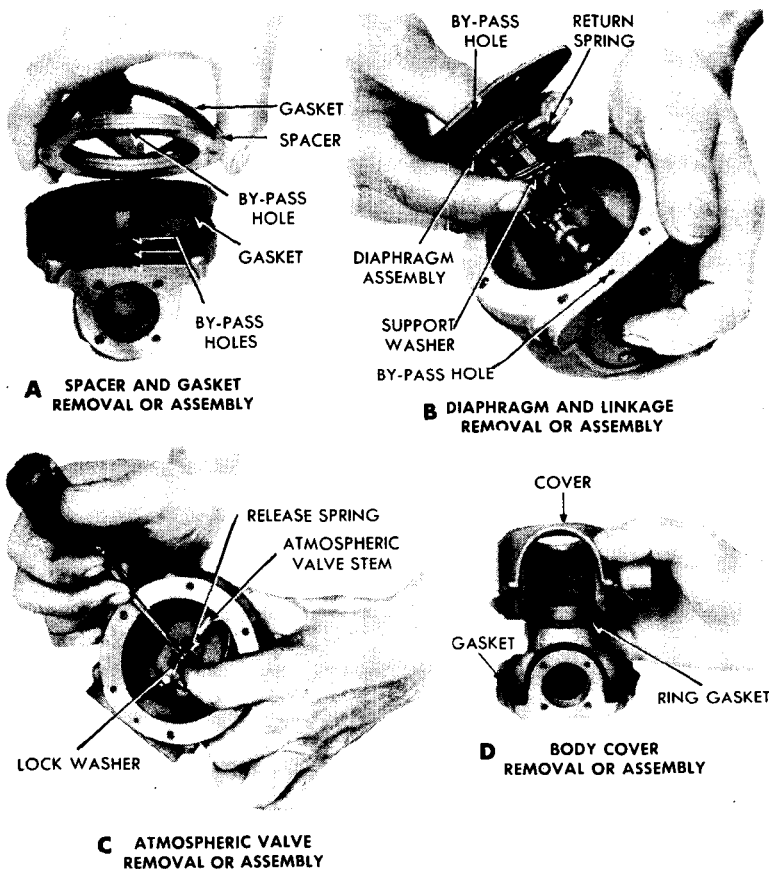
(2) Remove the four screws and lock washers which attach the valve body dust cover to the control valve, and remove the cover and gaskets.

(3) With thumb on diaphragm (B, fig. 15), place two fingers under return spring support washer, and compress the return spring. Raise assembly out of body until the two linkage pins are disengaged from valve stem notches. With other thumb push vacuum valve out of valve body. Remove diaphragm and linkage assembly.

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(4) With open side of horseshoe washer up, compress spring on atmospheric valve stem, and remove washer from stem. Remove atmospheric valve and spring.

i. **Disassemble Center Plate** (fig. 16). Remove snap ring, washer, and leather seal from center plate.



RA PD 312246

Figure 15—Control Valve Disassembly

9. CLEANING.

a. **Preliminary Instructions.** Remove all dirt from hands with soap and water, and dry thoroughly with a clean cloth. Place all parts on clean paper or cardboard after they have been cleaned.

b. **Clean Parts.** Wipe the exterior of all parts with a clean cloth. Wipe the bore of the slave cylinder and hydraulic adapter with clean cloth. Wash any grease or dust from parts with carburetor cleaning

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solution and rinse in dry-cleaning solvent. Blow out passages with compressed air. Place each part on a clean paper as it is cleaned.

10. INSPECTION AND REPAIR.

a. **Inspect.** Inspect cylinder shells for distortion, denting, or rust. Rust may be removed with a fine grade of steel wool. Inspect piston rod for corrosion or other damage. **CAUTION:** *Do not polish piston rod with steel wool.* Inspect hydraulic adapter and slave cylinder for scoring. **CAUTION:** *Do not hone or polish the bore.* Control valve, air and vacuum valve seats must be smooth and free from rust or pitting. **NOTE:** *A slight polishing with fine steel wool is permissible for slight scratches or corrosion on valve seats.* Inspect tubing and castings for breaks or cracks. Inspect hydraulic by-pass tube, vacuum tubing, and hose for kinks or cuts.

b. **Repair.** Using the proper repair kit for the model Hydrovac being repaired (par. 7), remove the contents of the carton and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective or worn.

Section III

ASSEMBLY AND TEST

11. ASSEMBLY.

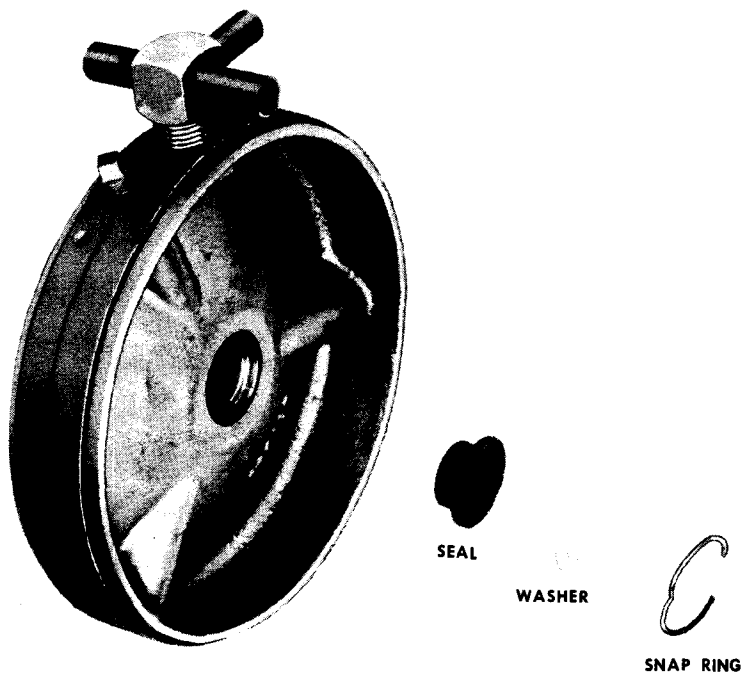
a. Assemble Control Valve.

(1) **INSTALL POPPET VALVES** (fig. 15). Place atmospheric poppet valve in lower hole in body assembly of control valve with the small spring on the valve stem between the guide posts. Compress the atmospheric valve spring completely with a small screwdriver, and insert horseshoe lock washer in groove of stem (C, fig. 15). Long-nose pliers may be used to insert lock washer. Turn the atmospheric valve until notch on stem faces up. Insert vacuum valve in body until end of stem is flush with outer end of second post, and with notch in stem down.

(2) **INSTALL DIAPHRAGM ASSEMBLY** (fig. 15). Install return spring on diaphragm assembly with large diameter against diaphragm plate. Install diaphragm support washer over linkage on diaphragm assembly. Line up one of the vacuum by-pass holes in diaphragm with by-pass hole in valve body at the vacuum valve seat opening. Compress the diaphragm spring with thumb on diaphragm and two fingers on washer. Holding diaphragm assembly over valve body, lower the two pins on triangular linkage against the lower valve

ORDNANCE MAINTENANCE VACUUM BRAKE SYSTEMS (BENDIX B-K)

stem. Push vacuum valve stem over the pins in the linkage. **NOTE:** *Be sure linkage pins seat in notches of both valves.* Shift the diaphragm support washer to fit over the two posts in the valve body. Check operation of linkage by depressing diaphragm, while holding finger against vacuum valve. Atmospheric valve should open and close. Install spacer ring and gaskets on valve body (A, fig. 15). **CAUTION:** *The by-pass hole in spacer plate must face and line up with by-pass hole in diaphragm.*



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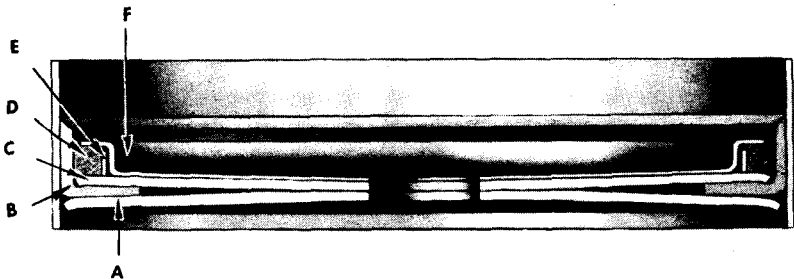
Figure 16—Center Plate—Partially Disassembled

(3) **INSTALL VALVE COVER** (fig. 15). Place valve cover in position, and install six screws and lock washers. Holding diaphragm spring slightly compressed with finger or tool inserted through hole in cover, tighten screws. **NOTE:** *Make sure the diaphragm remains flat on the flange and does not buckle between the screw holes.*

(4) **INSTALL VALVE BODY DUST COVER.** Carefully position ring gasket, spacer ring, and dust cover on valve body and install four screws, tightening evenly and securely (D, fig. 15).

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b. **Assemble Hydraulic Adapter** (fig. 14). Install small rubber piston cup on hydraulic piston plunger of hydraulic adapter. **CAUTION:** *Lip of piston cup must face outward, toward the button head of the piston plunger (flat side of cup on first).* Place piston stop in the flat end of adapter body with small end of stop first. Assemble fitting connection with a metal gasket on each side of fitting on flat end of hydraulic adapter housing. Install fitting bolt and tighten bolt finger-tight. Dip piston plunger assembly in hydraulic brake fluid, and insert in adapter housing bore, piston cup first. Install bleeder screw in adapter housing. Wipe gasket compound or shellac on threads of adapter. **CAUTION:** *Be careful no compound is on end of housing.* Screw adapter housing into control valve. **NOTE:** *Do not tighten jam nut at this time.*



RA PD 312248

Figure 17—Piston Assembly

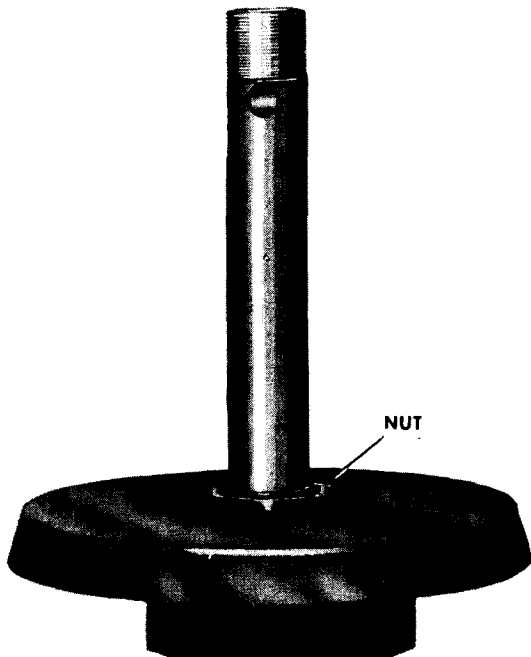
c. **Install Center Plate Seal** (fig. 16). Soak center plate leather packing seal in light shock absorber fluid. Place center plate on bench with its boss or hub down. Insert leather end seal in hole of center plate, small end first. **CAUTION:** *Leather seal must be set firmly in its recess.* Seat the leather seal, using special tool or round wood stock of proper diameter, and tap tool lightly with hammer several times. Install retaining washer, and install snap lock ring in groove. **CAUTION:** *Be sure leather and washer are centralized in the hub, and that lock ring is secure in bottom of groove. Use round wood stock to centralize washer.*

d. Assemble and Install Front Piston.

(1) Place leather packing (B, fig. 17) on top of piston plate "A" with the lip upward. Brush a ring of sealing compound around edge of hole in piston plate. Place the smaller piston plate "C" inside the leather packing with its lip down. Install oil felt "D" against inner wall of leather piston packing. Install felt expander ring "E" with the grippers pointing outward and upward. Hook notched end of expander ring securely under prong provided near the looped end of ring. Saturate felt, using oilcan filled with light shock absorber fluid. Place felt retainer plate "F" over the felt and expander spring. **NOTE:** *Register opening squarely over the loop in the expander ring.*

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(2) Screw the piston rod nut (fig. 18) down to the end of the threads on the opposite end of rod from the port holes. Wipe threads on piston rod with sealing compound or shellac. Place the piston on the piston rod. **NOTE:** *The lip of the leather packing must extend away from the piston rod.* Wipe threads on piston rod with sealing compound or shellac. Screw the other piston rod nut down until it is just flush with the end of the piston rod.



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Figure 18—Front Piston Installation

(3) Place assembly in vise (fig. 18) with piston rod up, and lip of leather packing down; tighten vise on end nut. **CAUTION:** *Make sure lip of leather piston packing is not bent out of shape when securing nut in vise.* Tighten the inner nut firmly against the piston plate. **NOTE:** *After final tightening, the lower nut should still be exactly flush with the end of the piston rod.*

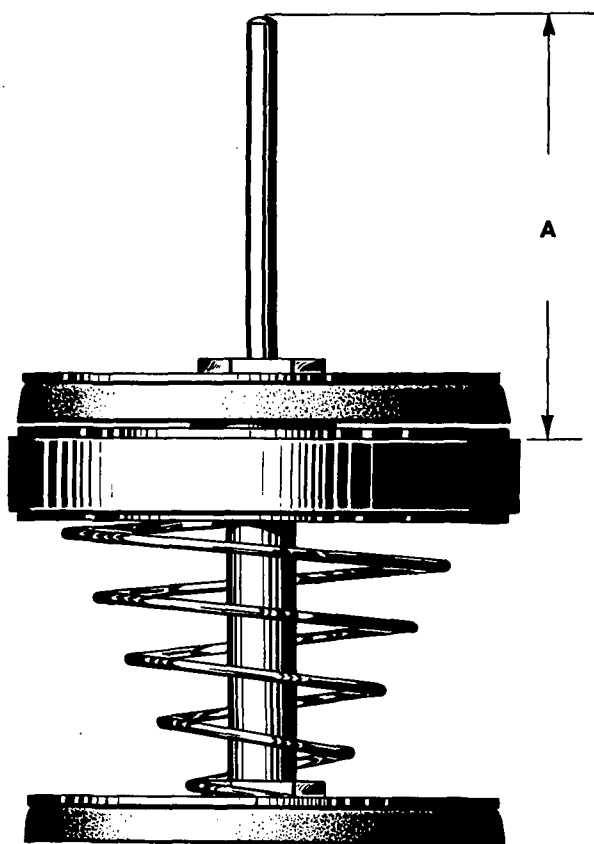
(4) Install return spring, small end first, against piston (fig. 12). Place center plate over large end of return spring, with the piston guide boss up, and snap ring side down. Compress piston return spring with the center plate, and hold in compressed position by clamping center plate to front piston, using a C-clamp with thumb screw end of clamp down. **CAUTION:** *Avoid damaging lip of leather packing.* Screw the inside piston nut for the rear piston down to the

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end of the threads on the piston rod. Wipe threads of piston rod with sealing compound or shellac.

e. Assemble and Install Rear Piston (fig. 17).

(1) Assemble the rear piston (subpar. d above). *NOTE: The H-66 Hydrovacs No. 372290 and No. 373380 have a hole drilled through the piston plates of the rear piston (fig. 26); otherwise, front and rear piston assemblies are identical for all Hydrovacs. When working on these Hydrovacs, be sure holes match so that there is a full opening. Place piston on piston rod (fig. 12). NOTE: Lip of leather packing must face down. Place the push rod in position in the recess in the end of the piston rod, and secure with the retaining pin. Wipe threads of piston rod with sealing compound or shellac. Install other nut on piston rod flush with rod end, and tighten the under nut securely (fig. 11). NOTE: Do not stake nut at this time.*



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Figure 19—Setting Push Rod Length

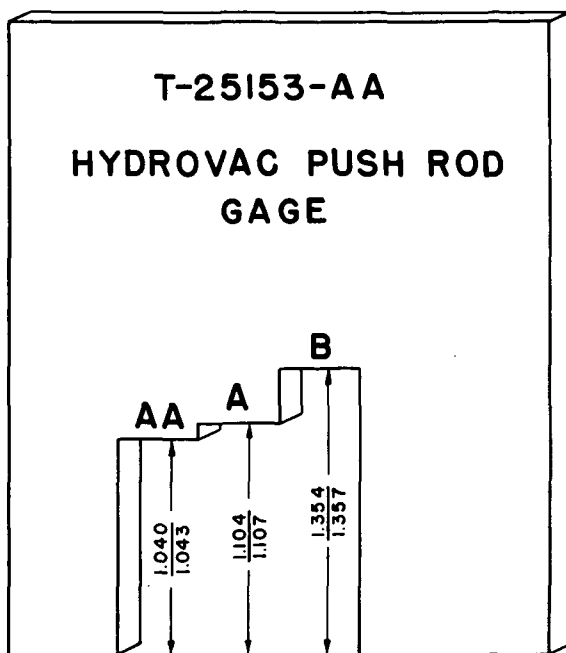
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(2) Remove C-clamp, allowing the center plate to come up against the upper piston. **CAUTION:** *The flange surfaces of center plate are sharp; remove C-clamp carefully to prevent cutting fingers.* Make preliminary adjustment by changing positions of upper and under nut until the distance "A" (fig. 19), from the center plate gasket surface to the end of push rod is between measurements shown below. Make this measurement with a depth gage.

H-66 Hydrovac 6 $\frac{3}{4}$ Piston 6.360 in.-6.390 in. (*6.322 in.-6.342 in.)

H-76 Hydrovac 7 $\frac{3}{4}$ Piston 7.251 in.-7.281 in. (*7.197 in.-7.217 in.)

*For units with grooved center plate (fig. 12).



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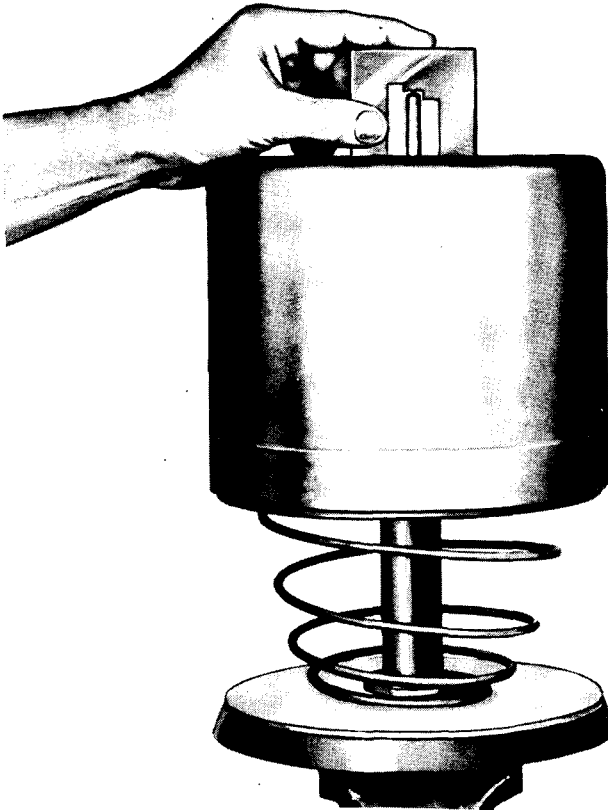
Figure 20—Tool for Setting Push Rod Length of All Hydrovacs

(3) **NOTE:** *For convenience, a gage can be made which can be used in conjunction with cylinder shell to check preliminary adjustments (fig. 20).*

(4) To adjust push rod length, place the rear cylinder shell, which has tube attached, in position over the piston and against shoulder on center plate (fig. 21). Prepare a gage as shown in figure 20 with three steps for use with all models of Hydrovacs. Step "AA" is for first series, Models H-66-3.3 and H76-4, with machined groove

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in center plate. Step "A" is for units without grooved center plates. Place legs of gage on surface of cylinder shell (fig. 21). Gasket must not be in place for this check. Push rod should pass through step of gage corresponding to model of Hydrovac being assembled. Clearance between push rod and proper step on gage must not be more



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Figure 21—Setting Push Rod Length with Gage

than 0.30 inch, measured with a feeler gage. Push rod length may be shortened by turning both nuts on upper end of piston rod counter-clockwise. Push rod length may be increased by turning both nuts on upper end of piston rod clockwise. **CAUTION: Be sure both nuts are tightened securely when checking push rod length with gage.** Rear cylinder shell must be removed and center plate must be held down with C-clamp when changing length of push rod. Remove rear cylinder shell from assembly.

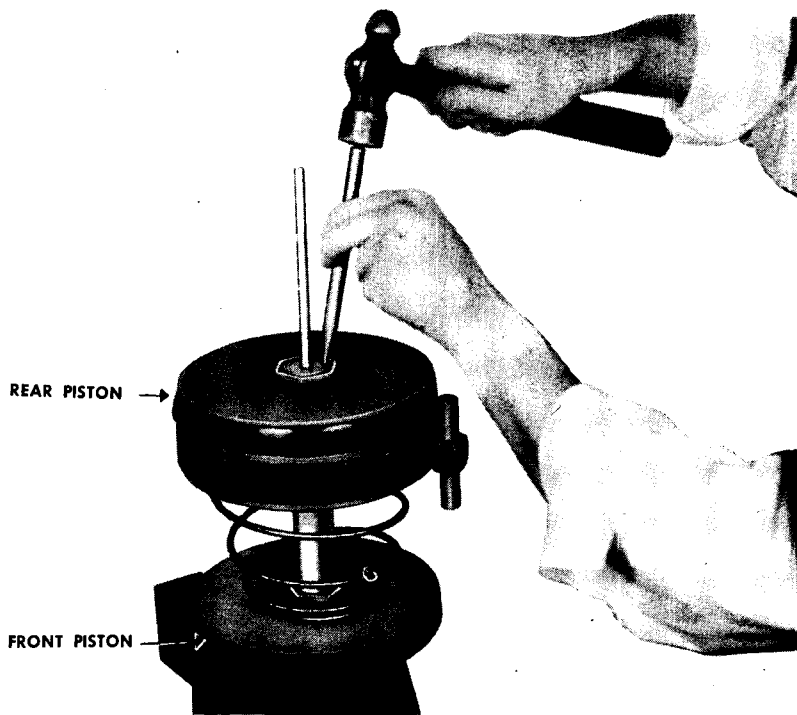
(5) Stake top nut to piston rod using a center punch and hammer (fig. 22). Hold center plate down with C-clamp, and tighten nut

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under top piston assembly securely. Invert piston assembly in vise with push rod down; clamp nut in vise. **CAUTION:** *Do not bend or distort push rod.* Stake front piston nut to piston rod, using a center punch and hammer (fig. 23).

f. Assemble and Install Slave Cylinder (figs. 9 and 24).

(1) Insert flat washer into flanged end of slave cylinder against lock ring (fig. 9). Dip the hydraulic rubber sealing cup in hydraulic



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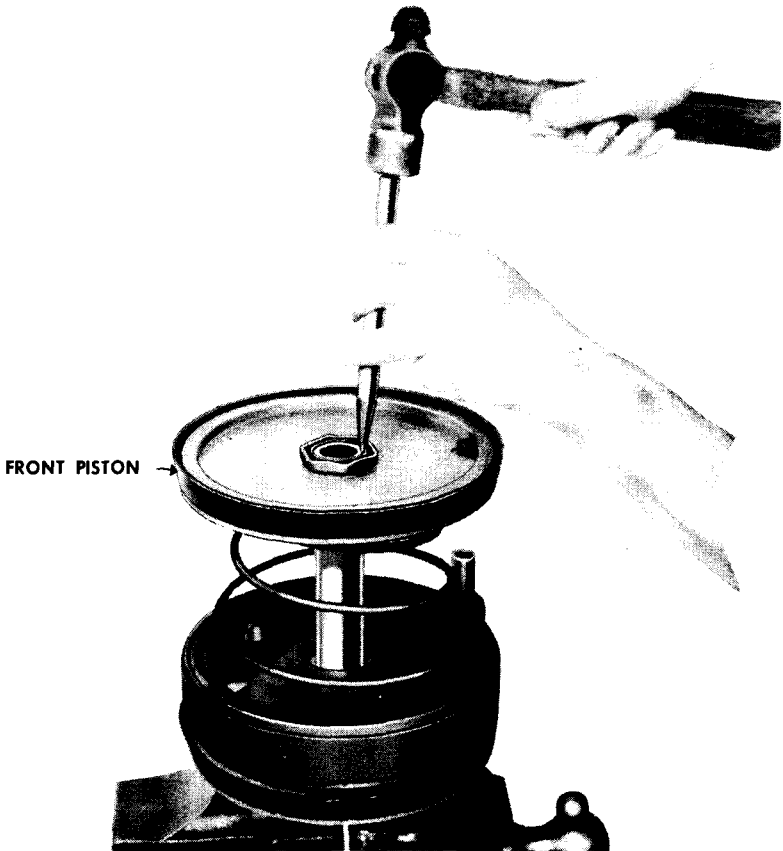
Figure 22—Staking Rear Piston Nut

brake fluid. **NOTE:** *This is the rubber cup with the smaller hole, if two different cups are provided. Either cup, if alike.* Insert sealing cup into slave cylinder with lip toward flat washer (fig. 9). Place rubber band gasket on smaller diameter of piston rod guide and seal assembly. Install guide and seal assembly into slave cylinder. Assemble new gasket, rear mounting bracket, rear cylinder shell, and inner face plate to slave cylinder. **CAUTION:** *Make certain that bleeder valve ports of hydraulic slave cylinder face are parallel with tubing on rear cylinder shell. Check scribe marks.* Install four cap

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screws and lockwashers, tightening securely. Check alinement of scribe marks on slave cylinder, bracket, and shell.

(2) Dip hydraulic piston and valve assembly in hydraulic brake fluid (fig. 24). Insert piston and valve assembly, small end first, into threaded end opening of slave cylinder. Dip slave cylinder piston cup in hydraulic brake fluid. Place piston cup in slave cylinder, with lip



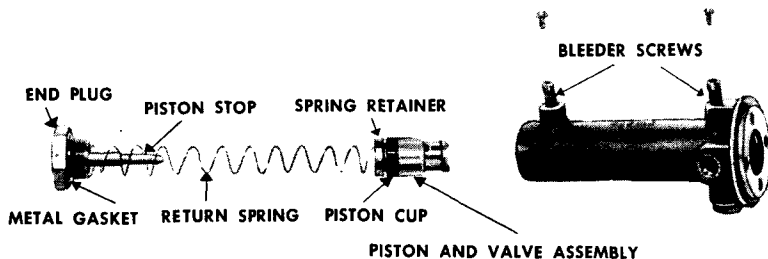
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Figure 23—Staking Front Piston Nut

of cup outward. **CAUTION:** Make certain piston cup is squarely against hydraulic piston and is not cocked. Install spring retainer into cylinder against cup with small end first. Place end of return spring in spring retainer. Place piston stop over outer end of return spring, point first. Place metal gasket on slave cylinder end plug. Place plug over head of stop, compress spring, and screw the plug into slave cylinder, finger-tight.

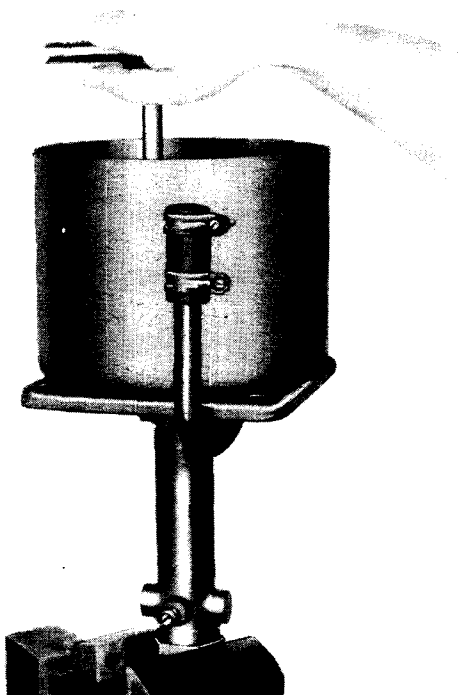
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(3) Remove piston and rod assembly from vise, and lay on clean surface. Place end plug of slave cylinder in vise with cylinder shell up, gripping end plug securely. **CAUTION: Do not clamp slave cylinder housing in vise, as cylinder will become distorted.** Again tighten the four cap screws which hold face plate and shell to slave



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Figure 24—Slave Cylinder—Partially Disassembled



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Figure 25—Securing Shell to Slave Cylinder

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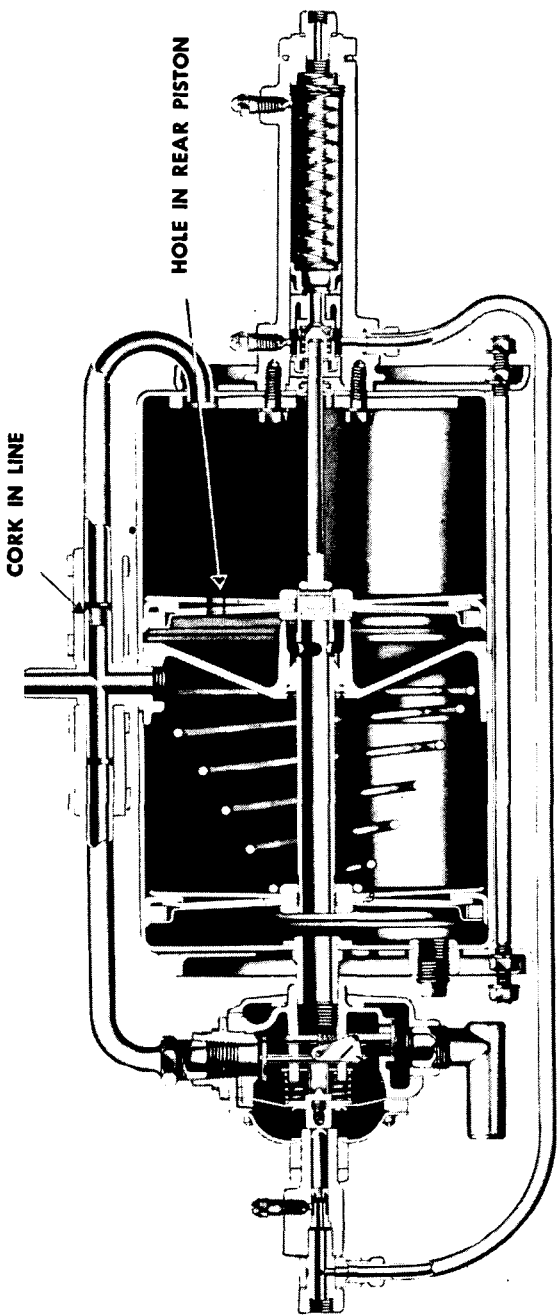


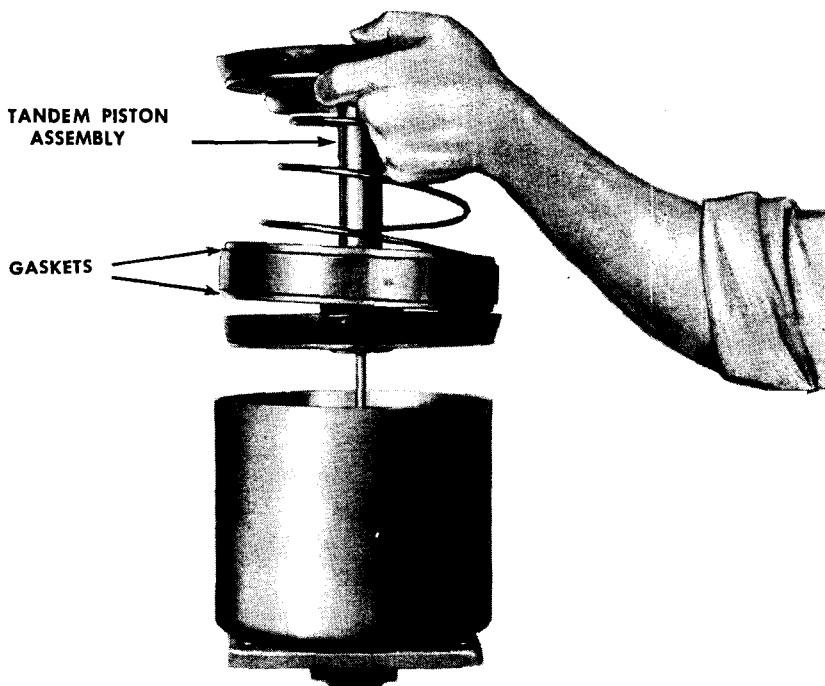
Figure 26—Sectional View of Hydrovac Nos. 372290 and 373380

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cylinder (fig. 25). *NOTE: The H-66 Hydrovacs No. 372290 and No. 373380 must have a cork inserted in the end of the rear cylinder tubing at the hose connection end (fig. 26).*

g. Assemble Subassemblies.

(1) **INSTALL PISTON ASSEMBLY.** Place new gaskets against shoulders of both sides of the center plate (fig. 27). Apply a liberal coat of light shock absorber fluid to walls of cylinder shell. Dip the piston leathers in light shock absorber fluid. *NOTE: Use a shallow*



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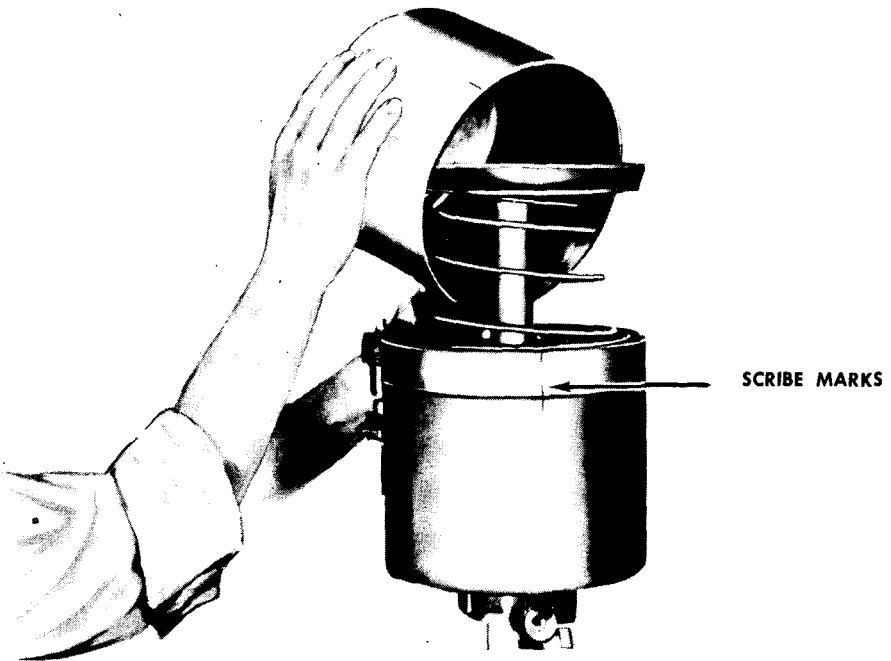
Figure 27—Installing Piston Assembly

pan and rotate the assembly, or brush a liberal film of fluid on the sides of the piston leathers. Place piston assembly in the rear cylinder shell, and push rod down. CAUTION: Make sure push rod enters the guide and seal assembly in slave cylinder, and edge of shell seats against gasket on center plate.

(2) **INSTALL FRONT CYLINDER SHELL** (fig. 28). Tilt cylinder shell at an angle. Install, while tilted, over piston until piston is fully within shell. Straighten shell on piston. Force shell firmly against gasket on center plate. Line up cylinder shells and center plate with the scribe marks which were made before unit was disassembled.

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Install bracket with flat side against cylinder shell. Install the through bolts. Lay unit on its side on the bench, and tighten the through bolts evenly and securely. **CAUTION:** *Do not distort unit or mounting brackets.* Install the two bleeder screws in the slave cylinder. Tighten end plug in slave cylinder as tightly as possible, and set by striking wrench with soft hammer.



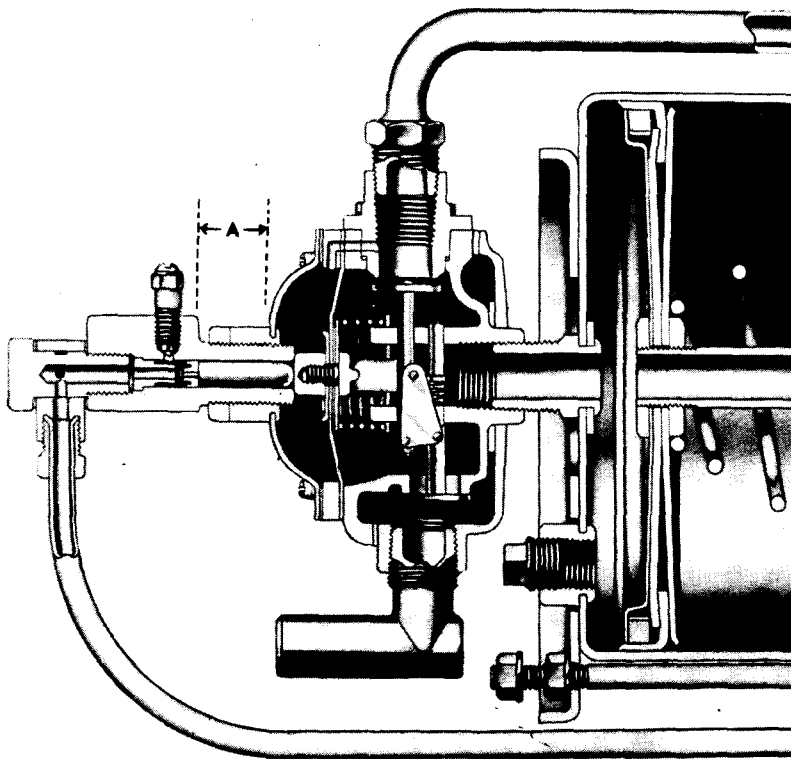
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Figure 28—Installing Front Shell

h. Install Control Valve. Place shellac or sealing compound on the threads of the front cylinder fitting, and install control valve with vacuum port in alinement with T-fitting on center plate. Control valve vacuum tubing must line up with rear cylinder tubing, and shellac or sealing compound must be used on threads of control valve. Install valve seat and tube assembly on control valve, using new gaskets, and tighten the four screws with lock washers securely. Turn the hydraulic adapter into the control valve cover until the distance between the shoulder on the adapter housing and the control valve cover at the boss is between $1\frac{1}{16}$ inch and $1\frac{5}{16}$ (A, fig. 29) while the bleeder screw port on the adapter is lined up with bleeder screws on slave cylinder at opposite end of unit (fig. 29). Tighten the jam nut which locks the hydraulic adapter to the control valve. Replace the bleeder screw. **NOTE:** *Recheck distance between adapter and control valve cover, and be sure the three bleeder screws of assembly are in line.*

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i. **Final Assembly** (fig. 4). Slide hoses onto T-fitting, and tighten hose clamp screws securely. Connect the hydraulic tube assembly to slave cylinder and then to hydraulic adapter fitting, and tighten connections securely. *NOTE: If fitting will not thread easily into connection at hydraulic adapter, loosen the fitting bolt. Tighten fitting bolt on end of hydraulic adapter as securely as possible. Install hydraulic tube clamp and identification tag on center plate with screws and lock washer. Cover all openings with masking tape or plug with corks to prevent dirt from entering unit.*



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Figure 29—Setting Hydraulic Adapter Measurement

12. ON-VEHICLE TEST.

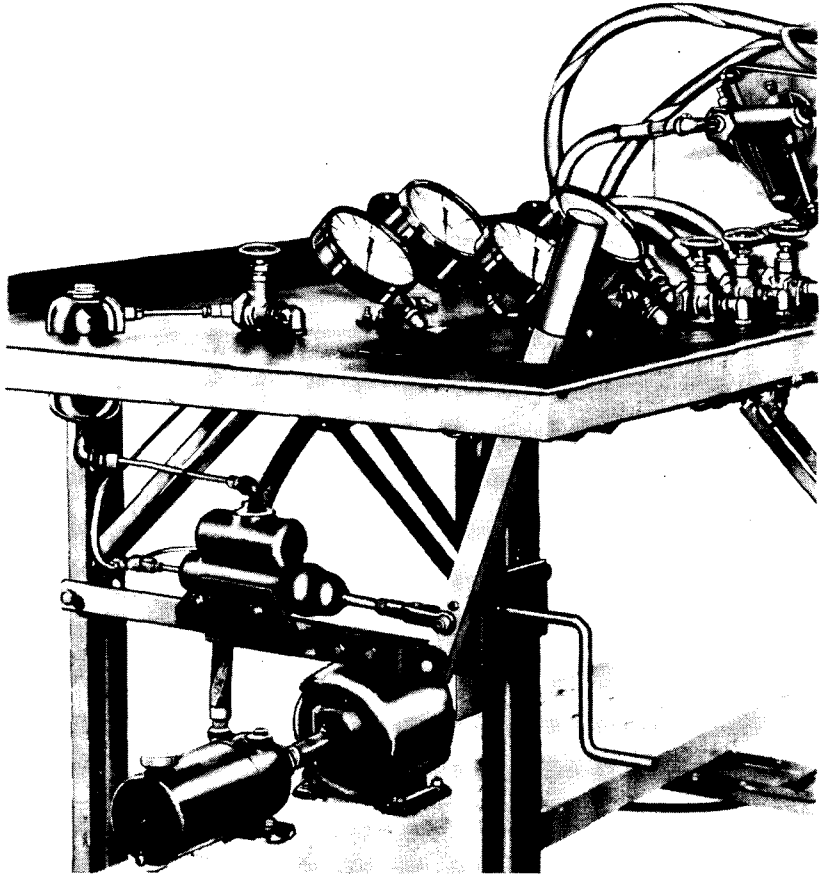
a. **General.** If a test bench is not available for testing the Hydrovac, it can be tested by installing it in a vehicle. The following instructions are based on the assumption that the Hydrovac is installed

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in the vehicle and connected to the engine manifold for vacuum and to the master cylinder for actuating hydraulic pressure.

b. Tests.**(1) PREPARATION.**

(a) Remove the pipe plug from the Hydrovac center plate tee and install a vacuum gage in the tee. This gage will be termed gage No. 1.



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Figure 30—Typical Test Bench

(b) Remove the pipe plug from the boss in the back end of the rear cylinder shell, and install a second gage. This gage will be termed gage No. 2.

(c) Install a hydraulic pressure gage in the front (outlet) end of the hydraulic slave cylinder or at one of the wheel cylinders.

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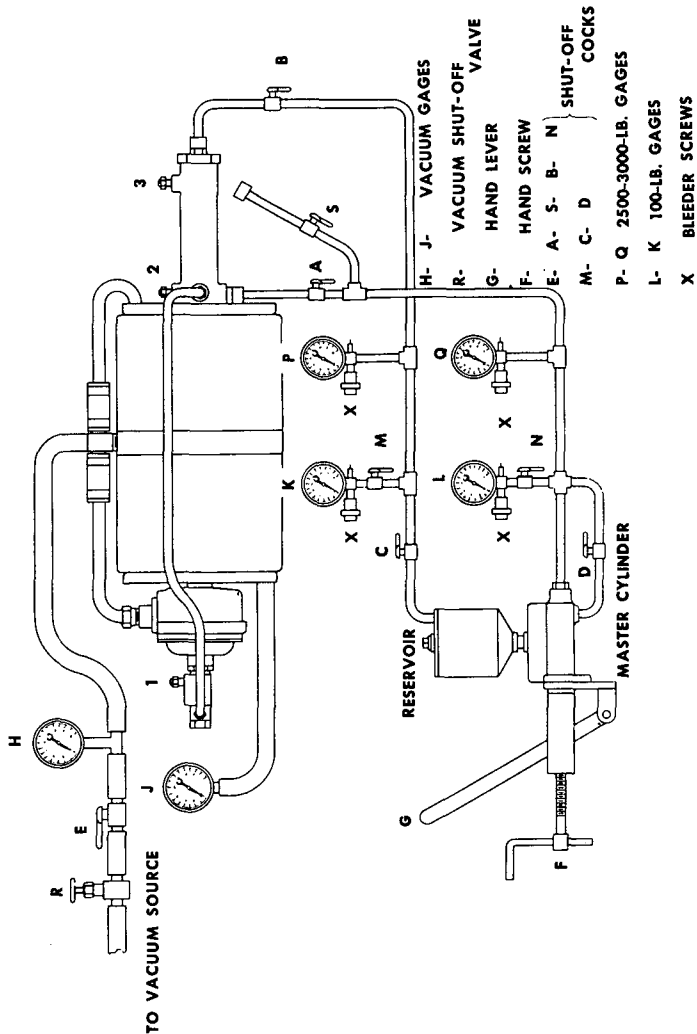


Figure 31 --Test Bench Diagram

HYDROVAC—FIRST SERIES**(2) VACUUM TEST (brakes released).**

(a) Start the engine and leave the brake pedal in the released position. Note the reading on both vacuum gages. They should register engine manifold vacuum and should be exactly alike. If the reading is below manifold vacuum, a leak exists in the Hydrovac or in the lines from the manifold check valve.

(b) Stop the engine and remove gage No. 1 from the Hydrovac center plate tee. Remove the vacuum line from the rear side of the center plate tee and connect gage No. 1 to the vacuum line. Start the engine and note the reading on gage No. 1. If the gage does not register manifold vacuum, the leak is in the manifold check valve lines, and they should be repaired or replaced.

(c) After repairing or replacing the manifold check valve lines, reinstall gage No. 1 in the Hydrovac center plate tee, connect the vacuum line to the rear side of the center plate tee, and repeat test (a).

(d) If the gages still register less than manifold vacuum, the leak exists in the Hydrovac. A leak in the Hydrovac can be caused by leaky gaskets, loose connections, or improper seating of the atmospheric relay valve. Any of these conditions would allow atmosphere to enter and break the vacuum sufficiently to cause the gage readings to be below manifold vacuum.

(3) VACUUM TEST (brakes applied).

(a) If, with the engine running and the brake pedal released, the gages both register manifold vacuum, depress the brake pedal and hold in the applied position. Note the reading of gages No. 1 and No. 2. Gage No. 1 should continue to register manifold vacuum while gage No. 2 should drop to zero or, if a combination vacuum and pressure gage is used, to atmospheric pressure.

(b) If gage No. 1 does not continue to register manifold vacuum, it may be attributed to one or more of the following causes: improper seating of the relay valve vacuum valve, loose or torn piston packing, torn diaphragm, or distorted cylinder shells. Disassemble the Hydrovac completely, and replace all worn or damaged parts.

(4) HYDRAULIC PRESSURE TEST.

(a) If proper readings of manifold vacuum and atmospheric pressure are registered on gages No. 1 and No. 2 with the brake pedal depressed, the following test should be performed to check the hydraulic slave cylinder for leaks.

(b) Stop the engine and depress the brake pedal several times to deplete the vacuum in the Hydrovac. Then depress the brake pedal, and note the reading on the hydraulic pressure gage at the hydraulic slave cylinder or at the wheel cylinder.

(c) Start the engine and depress the brake pedal, again noting the pressure gage reading. If the reading is not double the pressure reading with the engine stopped, a leak in the hydraulic system is indicated. Hold the pedal in the applied position for a few minutes, and note the pressure reading at various intervals. The hydraulic

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pressure should not drop quickly and should not drop below the reading attained at the moment of brake application.

(d) A low reading or drop of hydraulic pressure indicates a leak in the hydraulic slave cylinder, or in the brake lines or wheel cylinders.

(e) Inspect each brake line and wheel cylinder separately and repair or replace all worn or damaged parts. Repeat tests (b) and (c) above. If the hydraulic pressure is still too low or drops too rapidly, the leak is in the hydraulic slave cylinder. Completely disassemble the hydraulic slave cylinder, and replace all worn or damaged parts.

13. BENCH TEST.

a. **Preliminary Instructions.** For mass testing, a bench unit, similar to that shown in figures 30 and 31, is usually furnished. If the bench testing unit is not available, one can be built of miscellaneous parts and gages. Connect hydraulic lines and vacuum line and gages as shown in figure 31. Open hydraulic shut-off valves "A," "B," and "C." Close hydraulic valve "D" and vacuum valve "E." Have Hydrovac bleeder valves Nos. 1, 2, and 3 closed. NOTE: "S" *not used in first series.* Run master cylinder pressure screw "F" all the way out. Move master cylinder lever "G" through 8 or 10 complete strokes. This should completely fill the volume of the lines and Hydrovac slave cylinder with brake fluid. Close shut-off valve "C" and open bleeder valve No. 1. Pump the lever "G" until fluid appears at the bleeder valve, then close it. This eliminates the air in the Hydrovac jumper line. Also bleed bleeder valves Nos. 2 and 3 while pumping lever "G."

b. **Low-pressure Leakage Test.** Be sure vacuum shut-off valve "E" is closed and that vacuum gages "H" and "J" read zero. Open hydraulic shut-off valves "D," "M," and "N." Turn pressure screw "F" down until hydraulic gages "K" and "L" indicate 8 to 10 pounds. Hold in this position for several seconds. There should be no drop in hydraulic pressure.

c. **High-pressure Leakage Test.** Close valves "M" and "N." See that vacuum gages "H" and "J" read zero. Turn screw "F" down until hydraulic gages "P" and "Q" read 2,000 pounds. Hold in this position for several seconds. There should be no drop in hydraulic pressure in this length of time. Back off screw "F" to fully released position. NOTE: *If the master cylinder should travel to the end of its stroke before 2,000 pounds pressure can be raised, bleed all four hydraulic gages at the valve just under the gage. Also bleed screws Nos. 2 and 3 of the Hydrovac.*

d. **Operation Test.** Have hydraulic valve "D" open. Close valves "M" and "N." Open vacuum valve "E" to source of vacuum. Adjust vacuum regulating bleeder valve "R" to obtain 20 inches of vacuum at gages "H" and "J." Turn pressure screw "F" down until gage

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readings specified in the following chart are obtained. Then fully release pressure screw "F." All hydraulic gages should read zero and both vacuum gages read the same maximum vacuum in the released position.

OPERATION TEST SPECIFICATIONS

Hydrovac Part No.	Hydraulic Gage—Q	Hydraulic Gage—P	Vacuum Gage—H	Vacuum Gage—J
371830	300 lb	1200 to 1250 lb	20 in.	0 in.
372290	320 lb	800 to 850 lb	20 in.	0 in.
371730	320 lb	1120 to 1170 lb	20 in.	0 in.
372780	320 lb	1120 to 1170 lb	20 in.	0 in.
373380	320 lb	800 to 850 lb	20 in.	0 in.

e. Vacuum Leakage Test.

(1) RELEASED POSITION. Back pressure screw "F" all the way out. Open vacuum valve "E" until maximum vacuum is registered on gages "H" and "J," then close valve "E." Vacuum drop should not be more than 1 inch in 15 seconds.

(2) APPLIED POSITION. Open vacuum valve "E" and turn pressure screw "F" in until vacuum gage "J" reads zero. Close valve "E." Vacuum registered on gage "J" should not drop more than 1 inch in 15 seconds.

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CHAPTER 4

HYDROVAC—SECOND SERIES

Section I

DESCRIPTION, OPERATION, AND DATA

14. DESCRIPTION.

a. The purpose of the second series Hydrovac is the same as the purpose of the first series (see par. 5). This series Hydrovac is also furnished with a single vacuum piston, and is used to operate clutches or brakes. Some models are connected to master cylinder by two lines.

15. OPERATION.

a. Released (figs. 34 and 37) (All second series units). When engine is started, a vacuum is created in the Hydrovac compartments Nos. 1, 2, 3, and 4, suspending both vacuum pistons in a balanced vacuum. Piston return spring holds pistons in the off position, and push rod being clear of check valve in slave cylinder permits a direct hydraulic opening from master cylinder to wheel brakes. Control valve diaphragm has like vacuums on each side, and is held in the off position by the diaphragm return spring. When the vacuum in the Hydrovac is the same as the source vacuum, the poppet valve in vacuum check valve rests on its seat and, in the event of motor failure or rapid acceleration, traps the vacuum in the Hydrovac system in readiness for application of brakes.

b. Applied (fig. 35 and 38). As the foot pedal is depressed, fluid is forced from the master cylinder into the slave cylinder, through slave cylinder check valve, and into wheel brakes; this fluid also reaches the hydraulic piston in control valve, gradually forcing diaphragm (against tension of return spring) toward the applied position. Diaphragm movement closes vacuum valve, sealing off vacuum from intake manifold. After vacuum valve is seated, the atmospheric valve leaves its seat, permitting air from the air cleaner to enter compartment No. 3; thence through hollow piston rod into compartment No. 1, depleting the vacuum in both compartments. With a high vacuum still present on the rear of the vacuum pistons (compartments Nos. 2 and 4), atmospheric pressure on front ends (compartments Nos. 1 and 3), the vacuum pistons travel toward the slave cylinder, closing off the slave cylinder check valve and moving slave cylinder piston, forcing fluid under high pressure into the wheel cylinders. Manual effort from the master cylinder acts on

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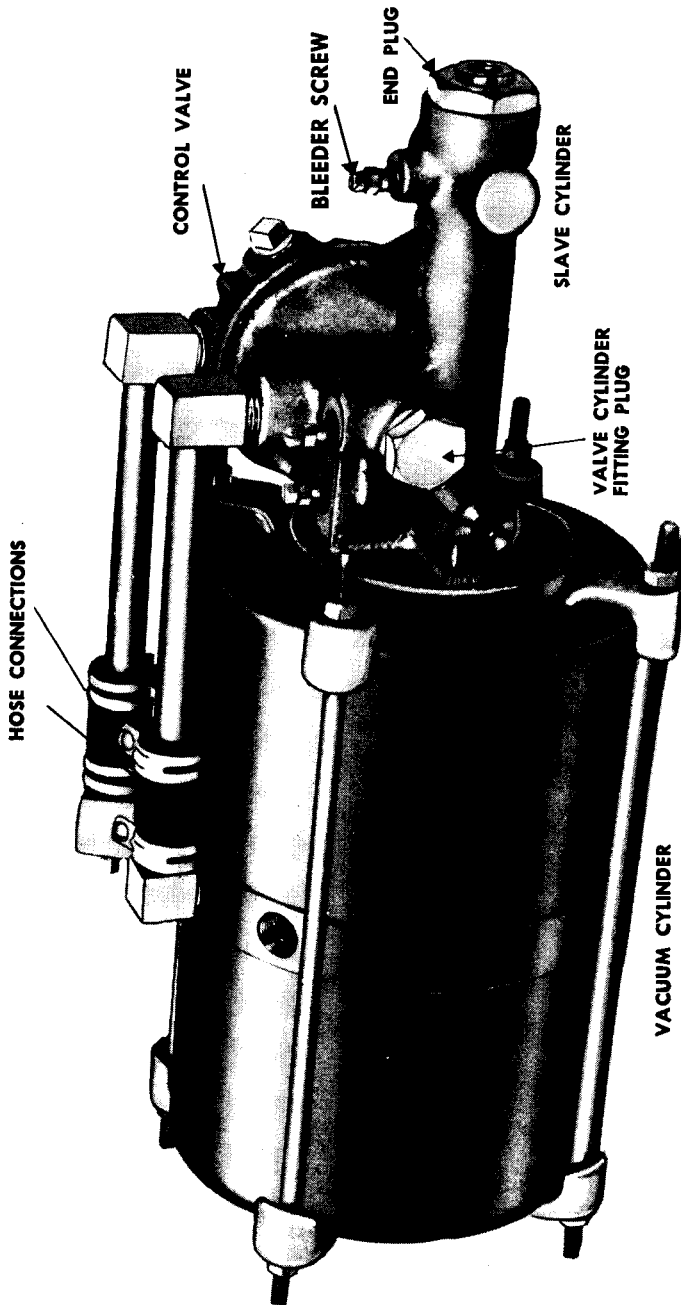
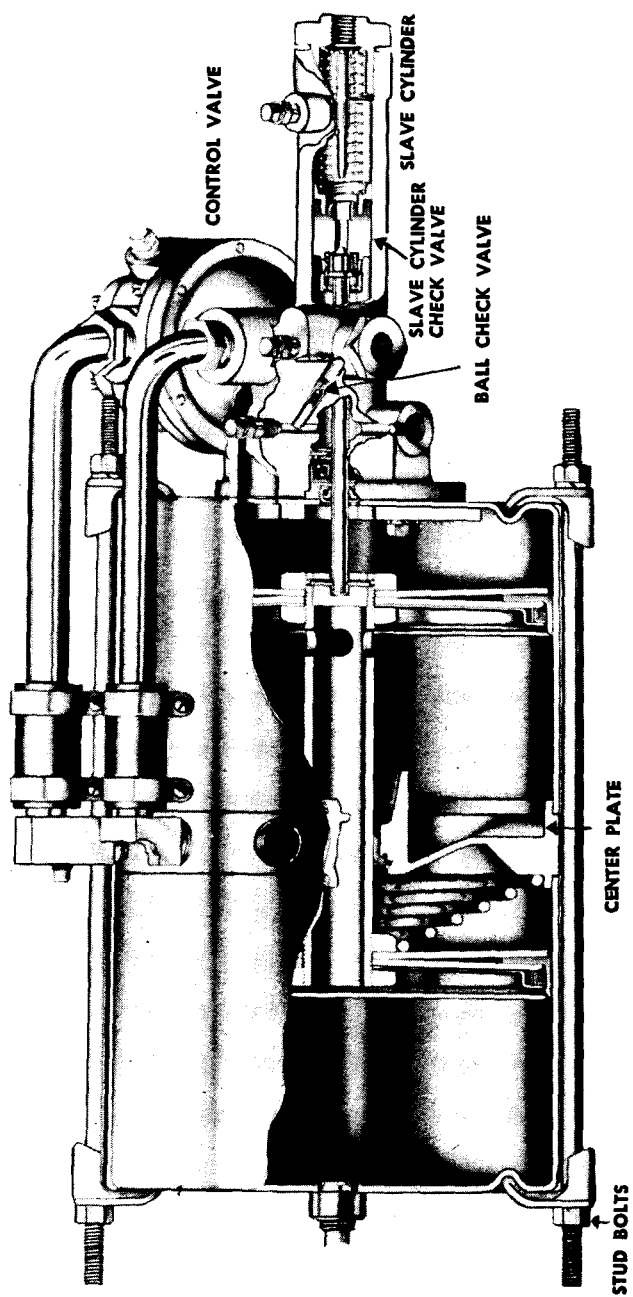


Figure 32—Hydrovac—Second Series, Single Line

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Figure 33—Sectional View of Hydrovac—Second Series, Dual Line

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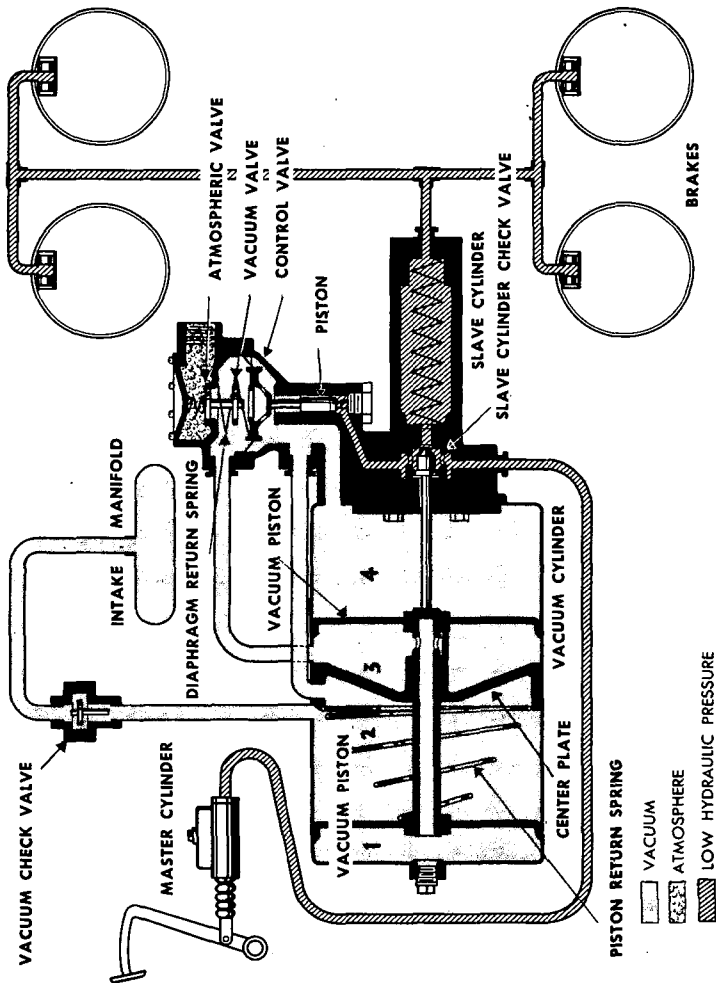


Figure 34—Schematic View of Hydrovac—Second Series, Single Line (Released)

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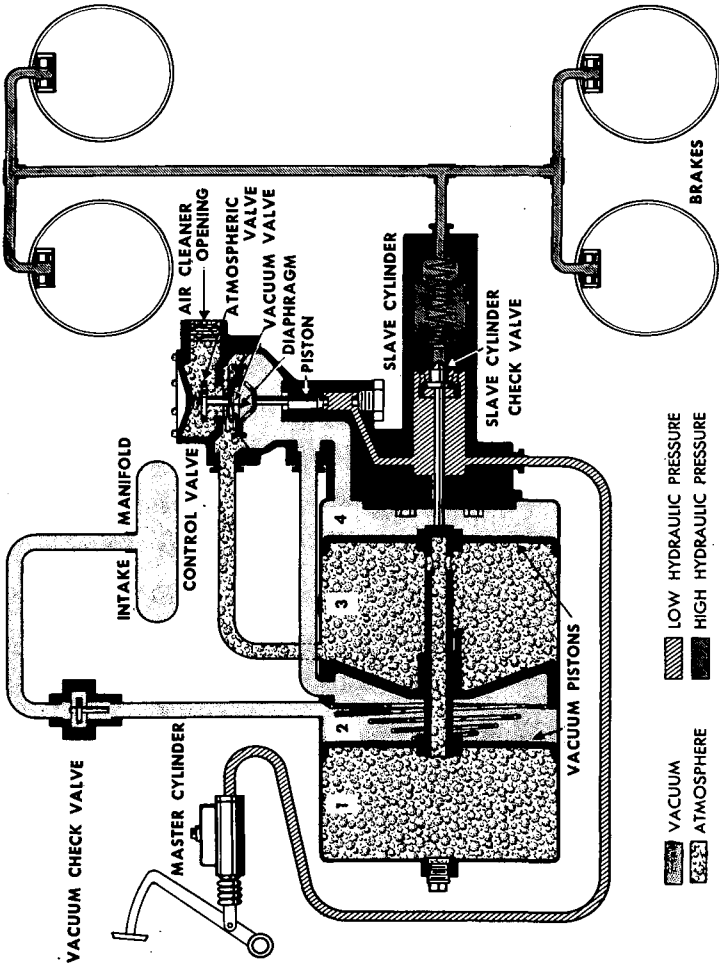


Figure 35—Schematic View of Hydrovac—Second Series, Single Line (Applied)

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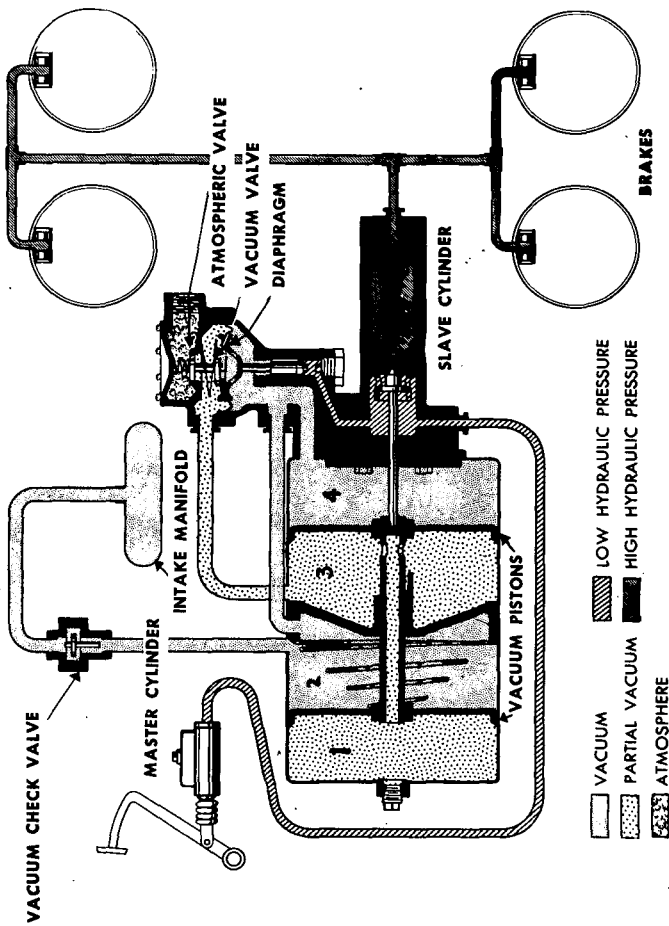


Figure 36—Schematic View of Hydrovac—Second Series, Single Line (Partial Application)

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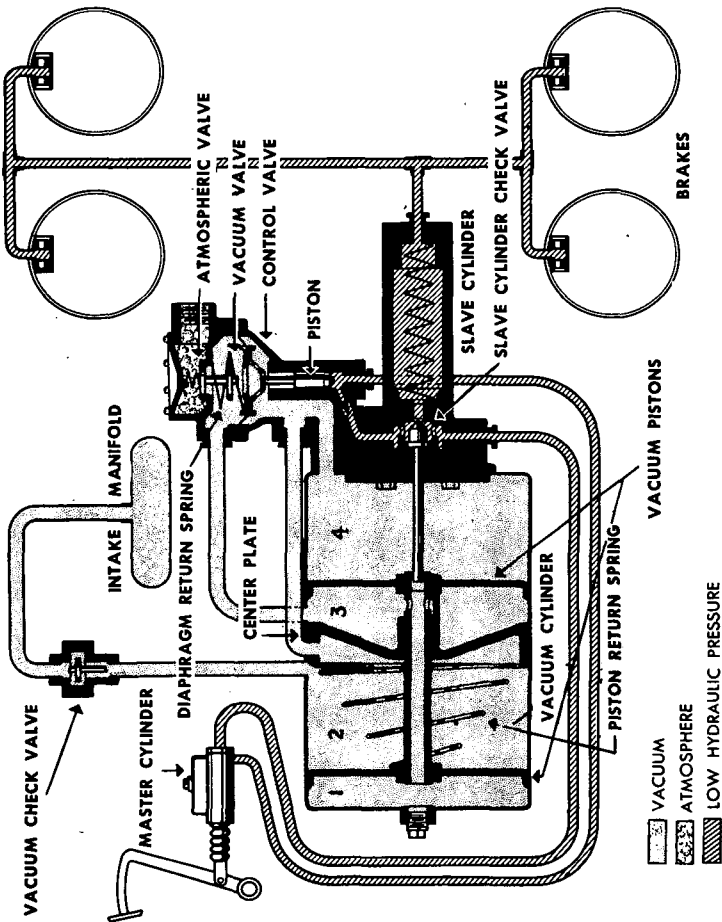


Figure 37—Schematic View of Hydrovac—Second Series, Dual Line (Released)

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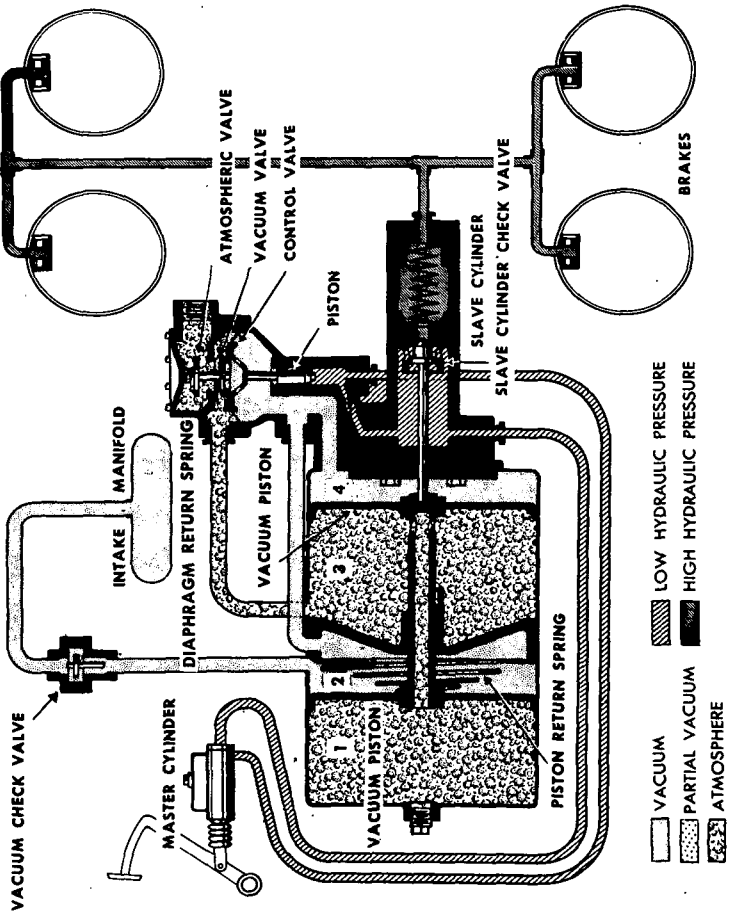


Figure 38—Schematic View of Hydrovac—Second Series, Dual Line (Applied)

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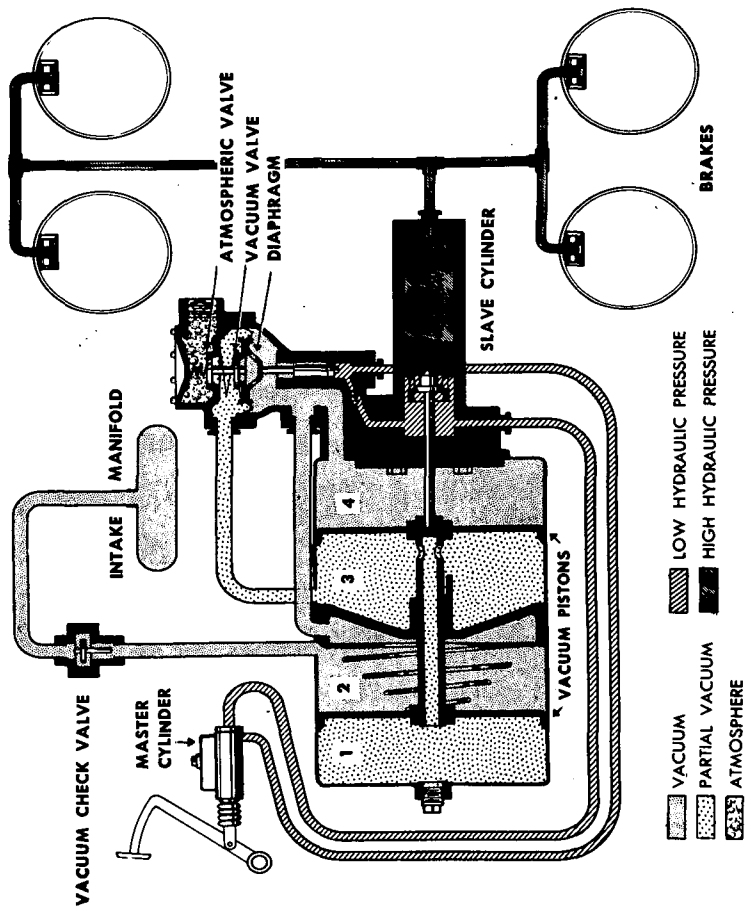


Figure 39—Schematic View of Hydrovac—Second Series, Dual Line (Partial Application)

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the rear of slave cylinder piston, assisting the vacuum pistons, thus the pressure at the wheel cylinders is the sum of the output of the vacuum pistons and the pressure from manual effort at the master cylinder. Release of foot pedal pressure allows diaphragm in control valve to return to released position, at which time the Hydrovac returns to the off position.

c. **Partial Application** (figs. 36 and 39). When the foot pedal movement stops at any point between released and applied positions, the diaphragm will cause vacuum and atmospheric valves to seat, holding vacuum pistons at the position attained when foot pedal movement ceased.

16. IDENTIFICATION DATA.

a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

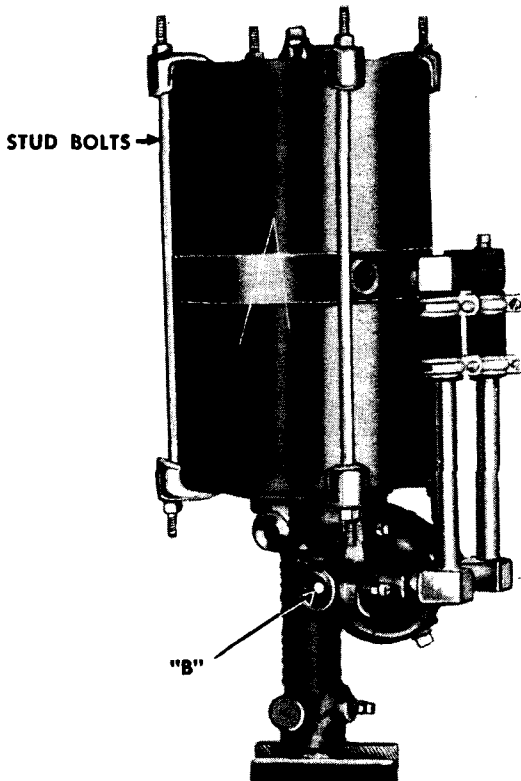
b. **Identification Data.** The following table is supplied to assist in identification of models and determining the repair kit to be used in repair of the unit.

Bendix Number	Ordinance Number	Model Number	REPAIR KITS	
			Bendix No.	Ordinance No.
373000	D-48439	H-25-25P-87	373301	A-303356
373163	D-72388	H-35-25P-96	373311	A-303359
373390	D-72366	H-34-10P-83	373430	A-303695
372774	D-72408	HS-25-25P-53	373310	A-303358
373100	D-72385	H-25-12V-93	373312	A-303360
373200	D-67196	HS-35-8-31 (Clutch operating)	373317	A-303365
373330	D-72378	H-32-16-65	373431	A-303697
373370	D-72368	H-35-8-81	373429	A-303902
372960	D-72426	H-35-16-88	373316	A-303364

c. **Translation of Model Number.** The above model numbers specify slave cylinder displacement, master cylinder line pressure, and total line pressure. The prefix "H" denotes Hydrovac. The prefix "HS" denotes a single-piston Hydrovac. The number accompanying the prefix specifies the slave cylinder displacement in tenths of an inch. The next number, when multiplied by 10, specifies the master cylinder line pressure required for valve runout at 16 inches of vacuum. When this number is followed by the suffix letter "P," it denotes that fluid for actuating the control valve is supplied through the internally drilled passage; that this passage contains no ball

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check valve; and that only one master cylinder hydraulic line is required. All Hydrovac units whose model designations do not include the suffix "P," utilize two hydraulic lines between master cylinder and Hydrovac unit. When followed by the letter "V," it denotes that the unit is mounted vertically. The last number, when multiplied by 10, specifies total line pressure at 16 inches of vacuum. **EXAMPLE:** Model HS-25-25P-53 signifies a single-piston Hydrovac piped directly to the master cylinder (not around check valve) whose slave cylinder displacement is 2.5 cubic inches, whose master cylinder line pressure required for valve run-out at 16 inches of vacuum is 250 pounds per square inch, and whose total line pressure at 16 inches of vacuum is 530 pounds per square inch.

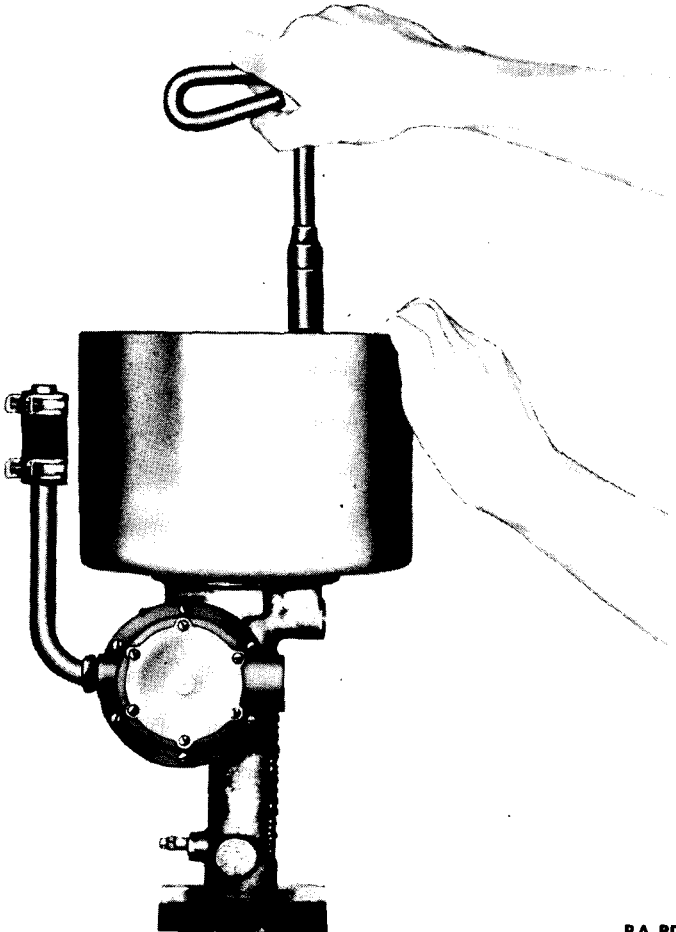


RA PD 312271

Figure 40—Hydrovac—Second Series, Partially Disassembled

HYDROVAC—SECOND SERIES**Section II****DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR****17. DISASSEMBLY.****a. Preliminary Instructions.**

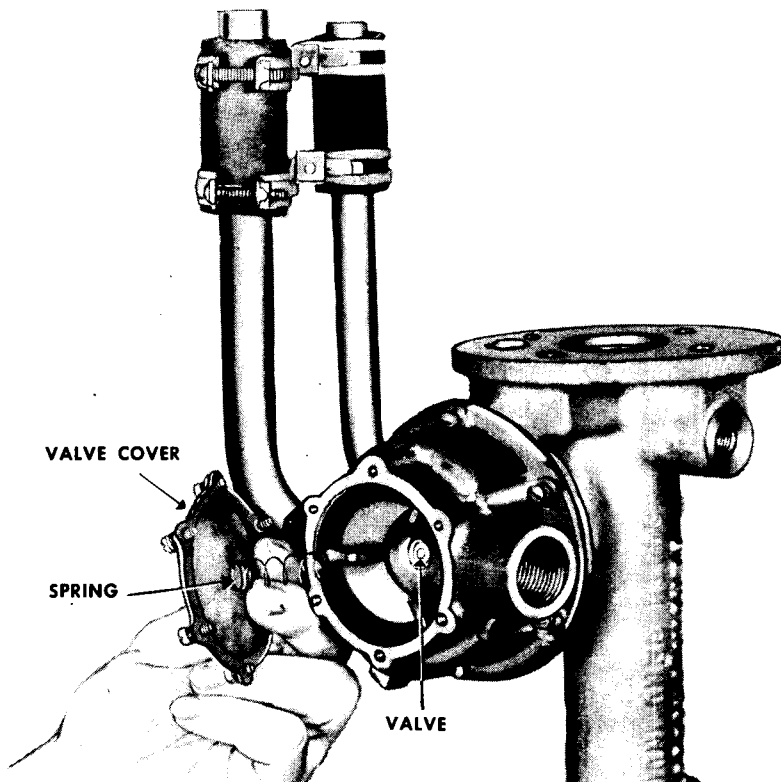
- (1) **CLEAN UNIT.** Wash all external surfaces.
- (2) **MARK POSITION OF PARTS** (fig. 40). Scribe a line across both cylinder shells, and center plate and brackets if attached. *NOTE: These lines must match to assure correct assembly.*
- (3) **REMOVE IDENTIFICATION TAG.** Loosen, but do not remove this end plug in the hydraulic slave cylinder. Remove manufacturer's



RA PD 312272

Figure 41—Removing (Installing) Shell

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Figure 42—Removing Valve Housing Cover and Spring

identification tag. NOTE: *The identification tag identifies the Hydrovac by a Bendix part number and facilitates ordering of the proper parts repair kit (par. 16).*

b. Remove Stud Bolts. Place Hydrovac in a vertical position in a vise, clamping the hydraulic slave cylinder end plug tightly as illustrated (fig. 40). With the end plug turned out three or four turns, it is possible to rotate the Hydrovac to facilitate dismantling. Loosen hose clamps on vacuum lines, and move hose back along tubing. Remove plug at "B" (fig. 40). Remove stud bolts and clamps which hold cylinder shells together.

c. Remove Piston Assembly. Separate upper shell from center plate. If the shell sticks to center plate, loosen it by tapping with a rawhide mallet. Remove center plate and piston assembly.

d. Remove Lower Shell (fig. 41). Remove shell by unscrewing cap screws with socket wrench. Shell removal will uncover guide

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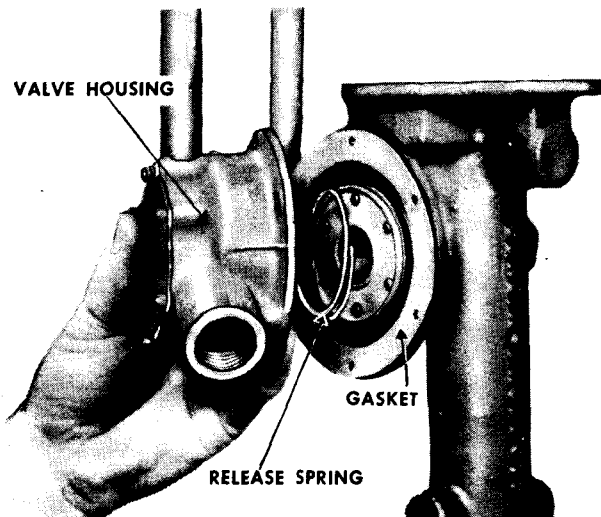
and seal assembly, rubber seal cup, and on some units, a spring. Remove all these parts.

e. **Remove Valve Cover and Spring.** See figure 42.

f. **Remove Valve Housing and Valve Release Spring.** See figure 43.

g. **Remove Diaphragm Assembly and Spacer.** See figure 44.

h. **Remove Valve Operating Piston.** Remove valve operating piston by pushing a small screwdriver or other convenient tool through hole from which diaphragm assembly rod was removed. (Be careful not to scratch the cylinder walls with the tool.) Remove lock ring and washer



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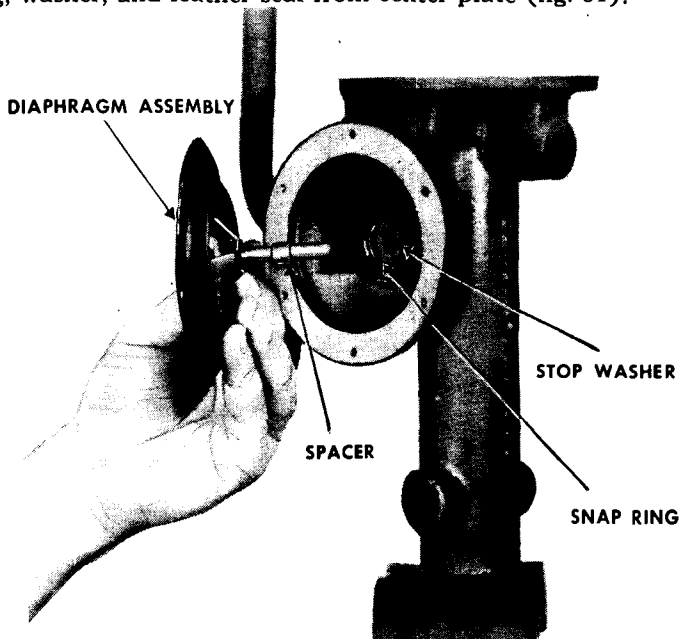
Figure 43—Removing Valve Housing

i. **Remove Slave Cylinder.** Unscrew slave cylinder from end plug; remove spring and stop (fig. 45). Push the hydraulic piston out through the plug end of the slave cylinder by inserting a rod or screwdriver in the opposite end. Remove snap ring and guide washer. **NOTE:** If the Hydrovac is of the double-hydraulic-line type, remove the ball check valve with a $\frac{3}{16}$ -inch blade screwdriver (figs. 33 and 46). Avoid damaging the hydraulic cylinder wall.

j. **Remove Valves.** To remove the poppet valves, drill the head off the valve stem (fig. 50). The service replacement valve stem is threaded at one end, instead of being riveted to the poppet valve, as in production.

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k. **Remove Vacuum Pistons.** Place piston and center plate assembly in a vise, clamping piston rod nut. Push center plate downward, compressing release spring. Hold center plate in this position with a C-clamp (fig. 47). Using two wrenches (fig. 11), remove upper piston rod nut, retainer pin, and push rod. Remove rear piston assembly and lower nut. Remove C-clamp, center plate, and return spring. Remove nut, piston assembly, and other nut. Remove snap ring, washer, and leather seal from center plate (fig. 51).



RA PD 312275

Figure 44—Removing Diaphragm Assembly

18. CLEANING.

a. **Preliminary Instructions.** Remove all dirt from hands with soap and water, and dry thoroughly with a clean cloth. Place all parts on clean paper or cardboard after they have been cleaned.

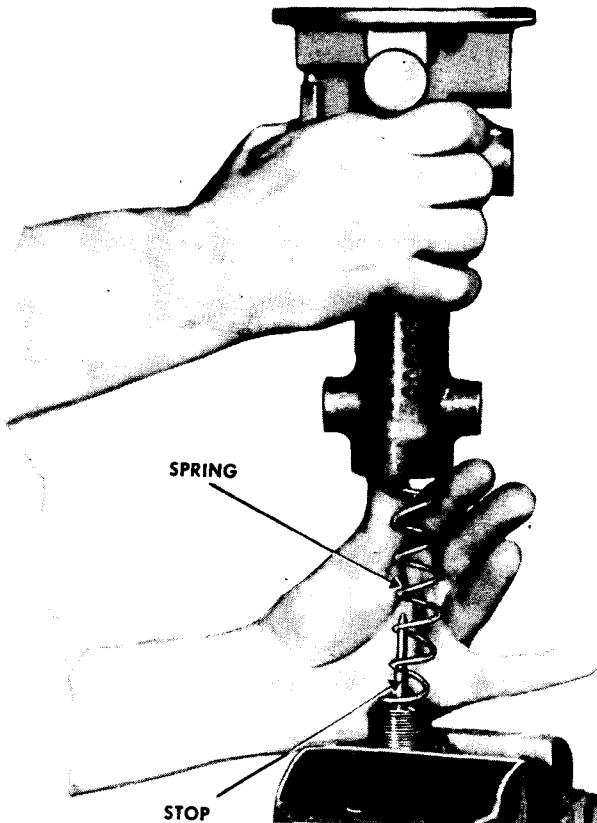
b. **Clean Parts.** Wipe the exterior of all parts with a clean cloth. Wipe the bores of the slave cylinder with a clean cloth. Wash any grease or dust from parts with carburetor cleaning solution and rinse in dry-cleaning solvent. Blow out passages with compressed air. Place each part on a clean paper as it is cleaned.

19. INSPECTION AND REPAIR.

a. **Inspection.** Inspect cylinder shells for distortion, denting, or rust. Rust may be removed with a fine grade of steel wool. Inspect

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slave and valve cylinder bores for scoring. **CAUTION:** *Do not polish piston rod, or slave and valve cylinder bores, with steel wool.* Inspect hydraulic adapter and slave cylinder for scoring. **CAUTION:** *Do not hone or polish the bore.* Control valve, and air and vacuum valve seats must be smooth and free from rust or pitting. **NOTE:** *A slight polishing with fine steel wool is permissible for minor scratches or corrosion.* Inspect tubing and castings for breaks or cracks.



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Figure 45—Disassembling Slave Cylinder

b. **Repair.** Using the proper repair kit for the model Hydrovac being repaired (par. 16), remove the contents of the carton and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective.

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Section III

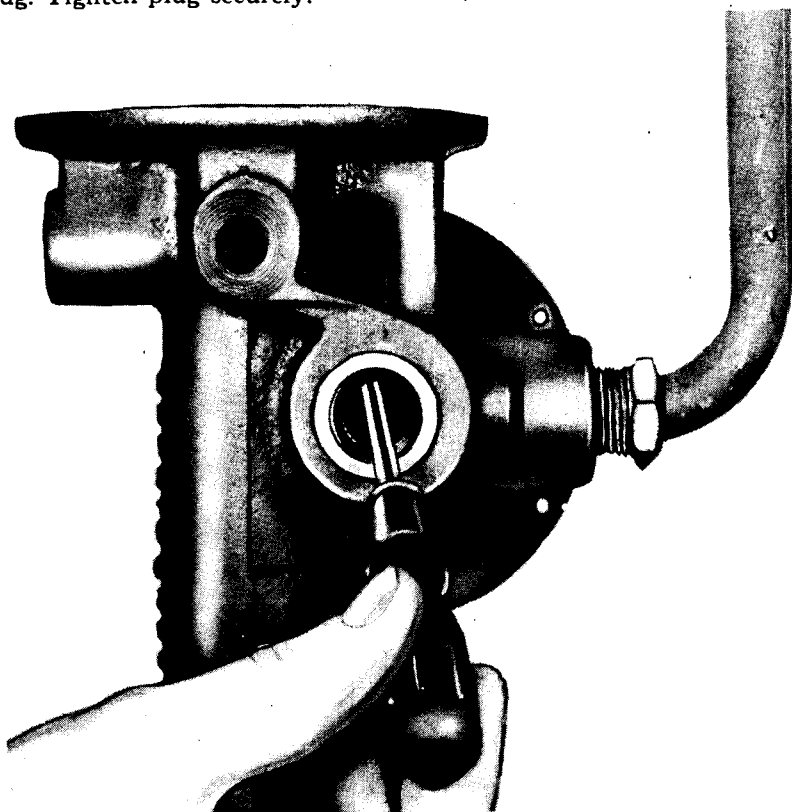
ASSEMBLY AND TEST

20. ASSEMBLY.

a. **Assemble Slave Cylinder.** Spread a film of light shock absorber fluid over the cylinder wall with the finger, and dip the rubber cup into this fluid just before assembly. Install snap ring, guide washer, and snap ring in slave cylinder bore (fig. 56). Install slave cylinder piston, cup, spring retainer, spring, piston stop, metal washer and end plug in the order illustrated in figure 48. Use the new parts included in the repair parts kit.

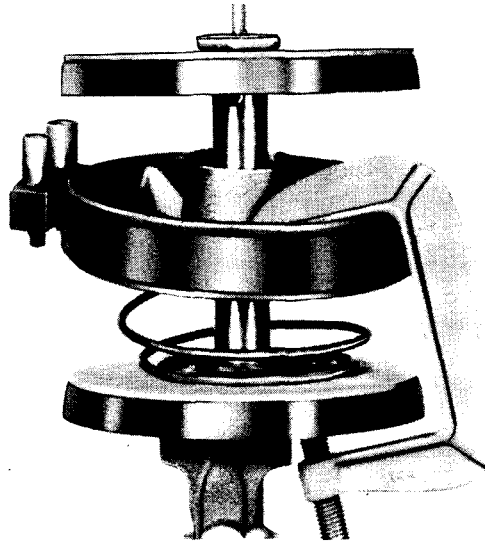
b. **Assemble Control Valve Section.**

(1) Install valve operating piston (fig. 49), metal washer, and plug. Tighten plug securely.



RA PD 312277

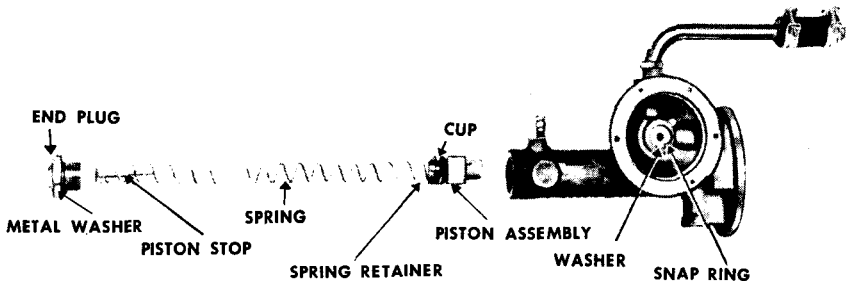
Figure 46—Removing Ball Check Valve

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Figure 47—Holding Center Plate

- (2) Install stop washer and snap ring (fig. 44 or 48).
- (3) Assemble new diaphragm and spacer (fig. 44).
- (4) Install service poppet valve assembly (fig. 50). Be sure to place lead washer under nut as shown. Tighten nut with a 4-inch wrench, holding end of stem with a drill chuck.



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Figure 48—Slave Cylinder Assembly

- (5) Assemble valve housing and release spring (fig. 43). Be sure spring is in recess at both ends. Install the gasket. Do not use grease or sealing compounds on the gasket.
- (6) Install valve cover and spring (fig. 42).
- (7) On Hydrovacs having a double hydraulic line, install new by-pass ball check valve, using a $\frac{3}{16}$ -inch screwdriver (fig. 46). Use

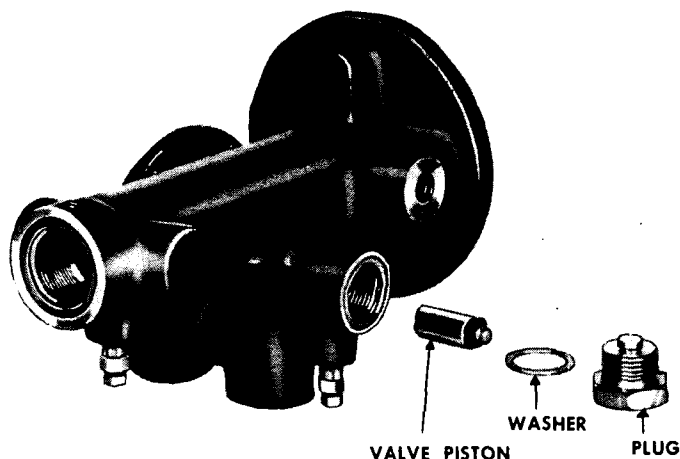
ORDNANCE MAINTENANCE VACUUM BRAKE SYSTEMS (BENDIX B-K)

a new lead gasket when installing this valve and be careful not to scratch the cylinder bore with the screwdriver. Tighten check valve securely.

(8) Install valve cylinder fitting plug and new gasket; tighten with a 10-inch wrench (fig. 32).

c. Assemble Vacuum Cylinder Assembly.

(1) **ASSEMBLE CENTER PLATE** (fig. 51). Install a new piston rod leather seal in the center plate after soaking the seal in light shock absorber fluid. Install washer and snap ring. Piston rod leather seal should be seated in center plate after assembly to prevent vacuum leaks between seat and seal in center plate.



RA PD 312280

Figure 49—Valve Piston Assembly

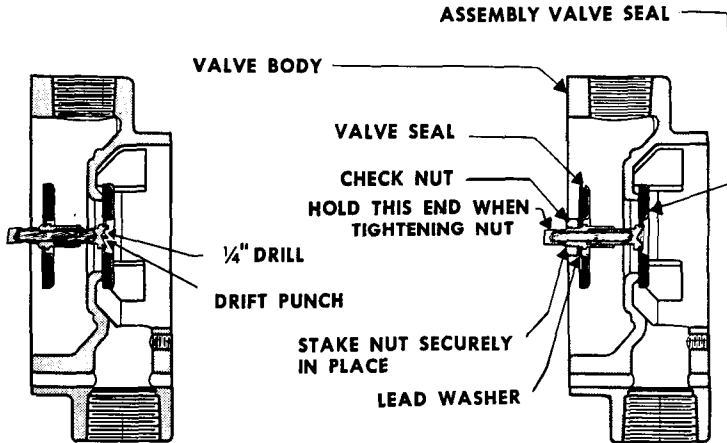
(2) **SEAT SEALS.** Seat the seals to prevent leaks by tapping them with a short length of round stock and a hammer. Use flat-end stock, $1\frac{5}{8}$ inches diameter, for units having $1\frac{1}{4}$ -inch piston rods, or $1\frac{3}{16}$ -inch diameter for units having $\frac{3}{4}$ -inch diameter piston rods.

d. Assemble Piston. Place the large diameter piston plate "A" in the ring. Brush a generous ring of shellac or sealing compound around the hole in piston plate. Place the leather packing "B" on top of the plate "A" with the lip upward. Place the smaller diameter piston plate "C" with the lip toward the leather packing. Install the oil felt "D" against inner wall of leather padding. Install felt expander ring "E," with the grippers pointing outward and upward. Hook the notched end of expander ring securely under prong provided near the looped end of the ring. Place felt retainer plate "F" over the felt and felt expander ring. Register opening squarely over the loop in the expander ring.

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e. Assemble Front Piston to Rod.

- (1) Run a piston rod nut down to the end of the threads on the end of the piston rod opposite the port holes (fig. 18).
- (2) Place the piston on the piston rod. The lip of the leather cup must extend away from the length of the piston rod. Coat threads of piston rod with shellac or sealing compound.



DISASSEMBLY OF PRODUCTION PARTS

NOTE:-

OPERATIONS NECESSARY TO REMOVE VALVE SEALS FROM VALVE BODY. (1) DRILL AS SHOWN. (2) USE DRIFT PUNCH TO KNOCK ADAPTER OUT.

REASSEMBLY OF SERVICE PARTS

NOTE:-

ASSEMBLE VALVE SEALS IN VALVE BODY AS SHOWN. CHECK NUT MUST BE SCREWED TIGHT AGAINST LEAD WASHER TO FORM VACUUM SEAL. USE NEW GASKETS WHEN ASSEMBLING AS PROVIDED IN KIT

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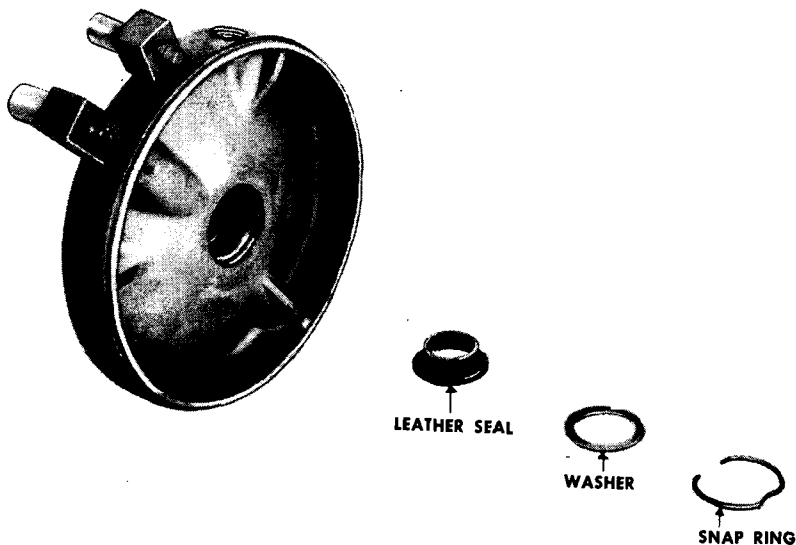
Figure 50—Schematic View of Poppet Valve Disassembly and Assembly

- (3) Turn the end nut down until it is just flush with the end of the piston rod. Tighten the other nut firmly against the piston plate with an 11-inch wrench. After final tightening, the outer nut should be flush with the end of the piston rod. Stake outer nut in three or four places with a center punch.

- (4) Clamp the outer piston nut in a vise (fig. 52). Place the piston return spring and center plate in position. (Large end of spring is to rest against center plate.) Be sure the center plate is right side up, that is, with the piston guide boss at the center extending upward.

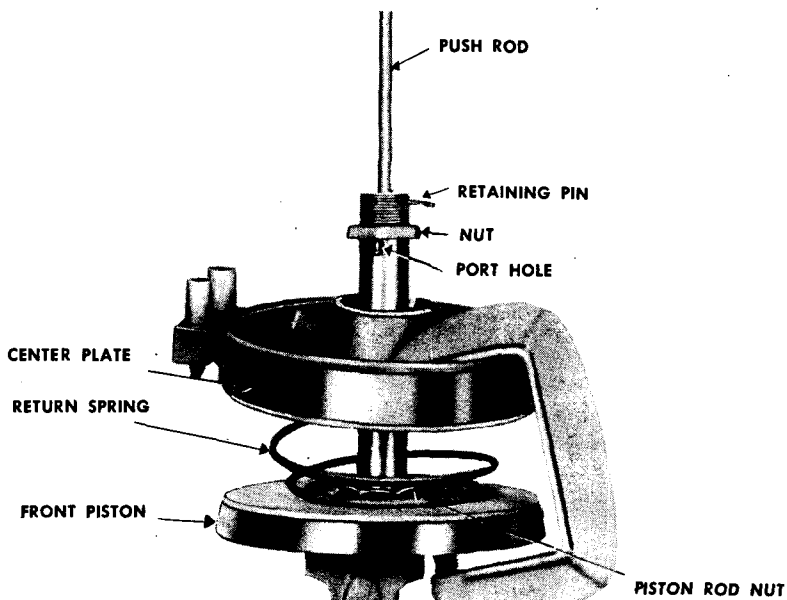
- (5) Compress spring and hold with a C-clamp as illustrated (fig. 52).

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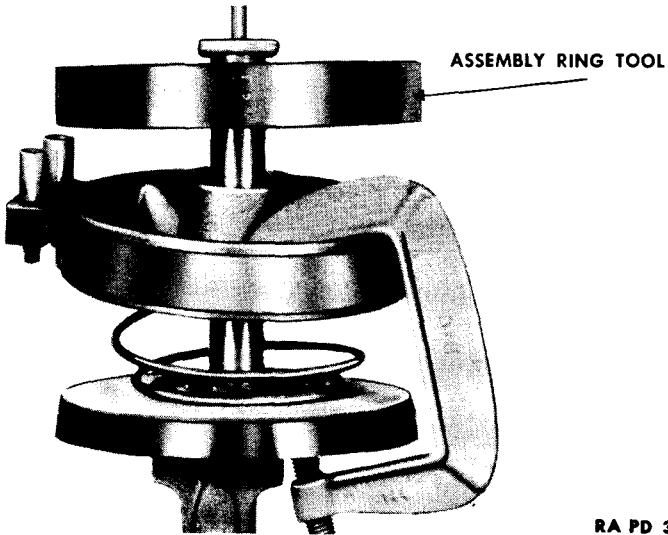
Figure 51—Center Plate Assembly



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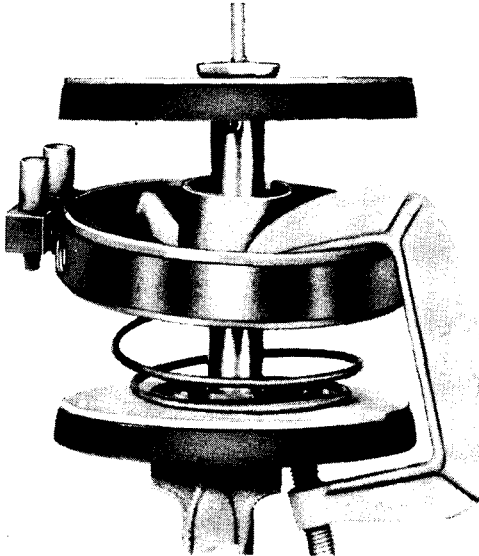
Figure 52—Assembling Piston Assembly

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RA PD 312284

Figure 53—Installing Piston, Using Assembly Ring Tool



RA PD 312285

Figure 54—Piston Installed, Assembly Ring Removed

f. Assemble Rear Piston to Rod.

(1) Turn a piston nut down to the end of the threads on the piston rod at the port hole end (fig. 52).

(2) Assemble the other piston as in paragraph 11 d (fig. 17), and place piston with lip toward center plate on the piston rod. Coat

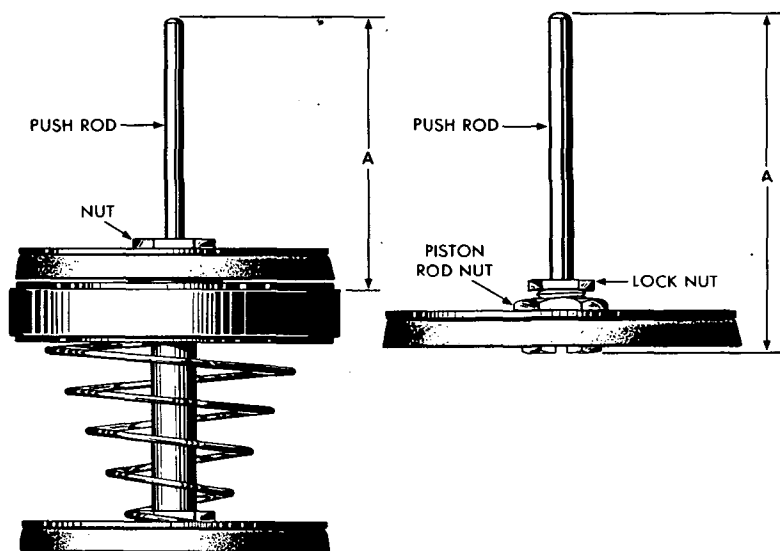
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threads of piston rod with shellac or sealing compound. Place the push rod in position and secure with the retaining pin (fig. 52).

(3) Turn down the outside piston nut until it is flush with the end of the piston rod (fig. 53).

(4) Bring the under or inside piston nut up against the piston plate and tighten securely. Do not stake the nuts at this time.

(5) Remove the C-clamp, and allow the center plate to come up against the piston.



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Figure 55—Setting Push Rod Length

g. Adjustment.

(1) The distance "A" (fig. 55) between the gasket surface of the center plate and the end of the push rod should be as shown below. If necessary, adjust the nuts so that the distance "A" is within the tolerances shown.

Hydrovac No.	Model No.	Dimension "A" In Inches
373000	H-25-25P-87	6.475 to 6.505
373050	H-35-16-117	6.810 to 6.840
373100	H-25-12V-93	6.270 to 6.300
373163	H-35-25P-96	7.152 to 7.172
373330	H-32-16-65	6.475 to 6.505
373370	H-35-8-81	7.142 to 7.172
373390	H-35-10P-83	7.142 to 7.172
373960	H-35-16-88	7.142 to 7.172

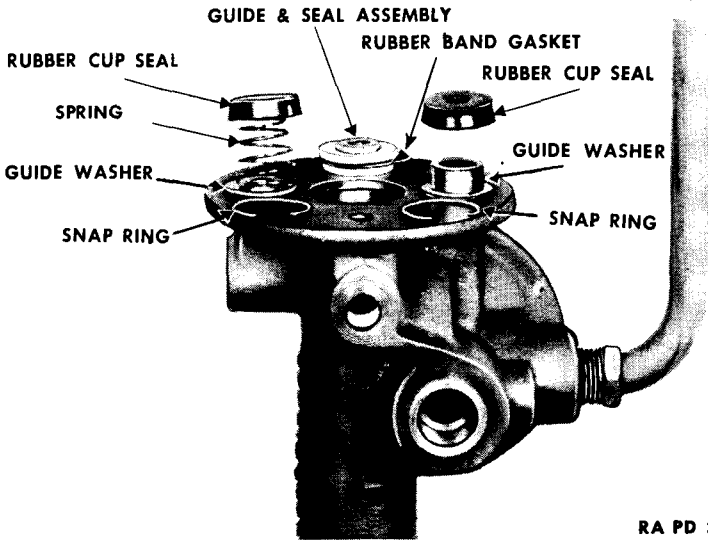
NOTE: In checking length of push rod on single-piston Hydrovacs, the distance "A" (fig. 55) should be as shown on page 63. If necessary,

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the lock nut and the push rod must be adjusted so that this distance "A" is within the tolerances shown.

Hydrovac No.	Model No.	Dimension "A" In Inches
373200	HS-34-8-31	6.605 to 6.625
372774	HS-25-25P-53	6.355 to 6.375

For convenience, a gage can be made (fig. 20) which can be used in conjunction with cylinder shell to obtain above measurements. Use step "B" on second series Hydrovacs. To use the gage, place the rear cylinder shell in position over the piston (fig. 21) against the shoulders of center plate. Do not use a gasket when making this measurement. Place the gage over the end of the push rod as illustrated (fig. 21).



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Figure 56—Seal Assembly

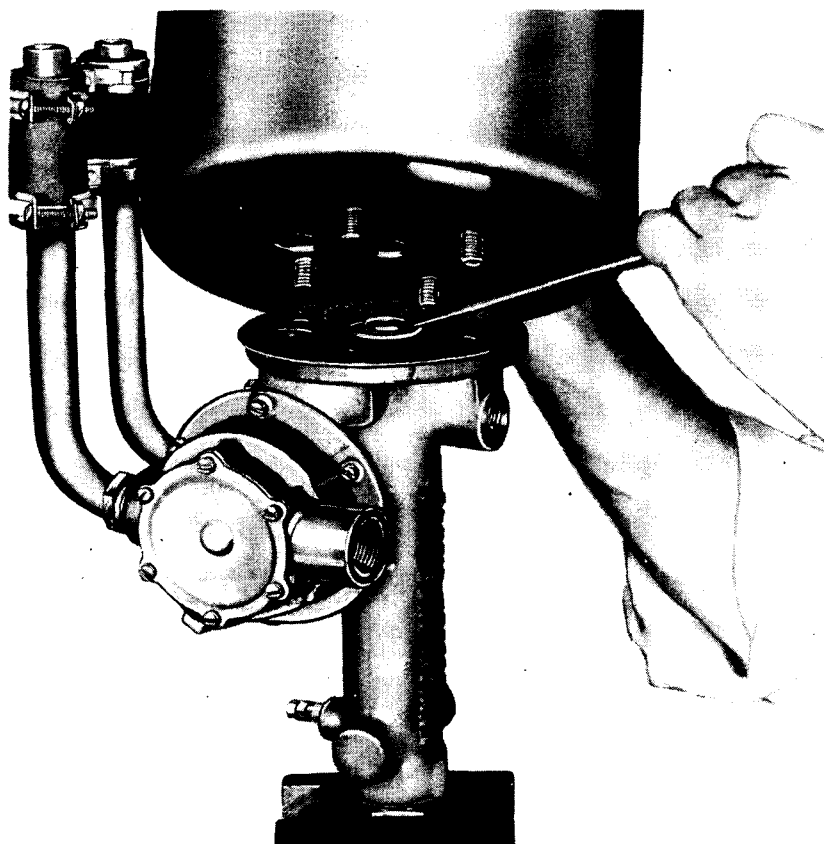
The clearance between the end of the push rod and the notch in the gage should not be more than 0.030 inch.

(2) If the length of the push rod does not come within these specifications, correct by adjusting the piston nuts. Screwing nuts further on piston rod lengthens push rod, and backing off nuts shortens push rod. Stake piston nut in two or three places after final tightening (fig. 22). Tighten nuts with an 11-inch wrench.

h. Final Assembly.

(1) Place slave cylinder and valve assembly in a vise, clamping the end plug (fig. 56). Dip rubber cup in light shock absorber fluid. Place a new gasket on flange of slave cylinder. Replacement of parts depends on the contents of repair kits. Install as illustrated in figure 56. If kit used contains the guide washer with the high collar, no spring is used and old spring, if any, is discarded. If kit contains a spring and Hydrovac also has a spring, install as originally installed.

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Figure 57—Installing Seal Assembly

Late type Hydrovacs are not equipped with spring, and if repair kits containing springs are used, discard spring and guide washer and use the guide washer in Hydrovac. *NOTE: The preferable combination is shown on right side in figure 56.* Place rubber band gasket on guide and seal assembly (fig. 56), and install guide and seal over rubber cup seal with flat side toward rubber cup seal (fig. 57). Hold assembly in position with a screwdriver (fig. 57) while installing the cylinder shell. Tighten cap screws, using a wrench with $8\frac{1}{2}$ -inch handle (fig. 41).

(2) Lubricate both piston assemblies by saturating felt wicks with light shock absorber fluid. Apply a film of light shock absorber fluid to the inner walls of both cylinder shells and leather piston packings. **CAUTION:** *Do not allow any oil to come in contact with slave cylinder parts.*

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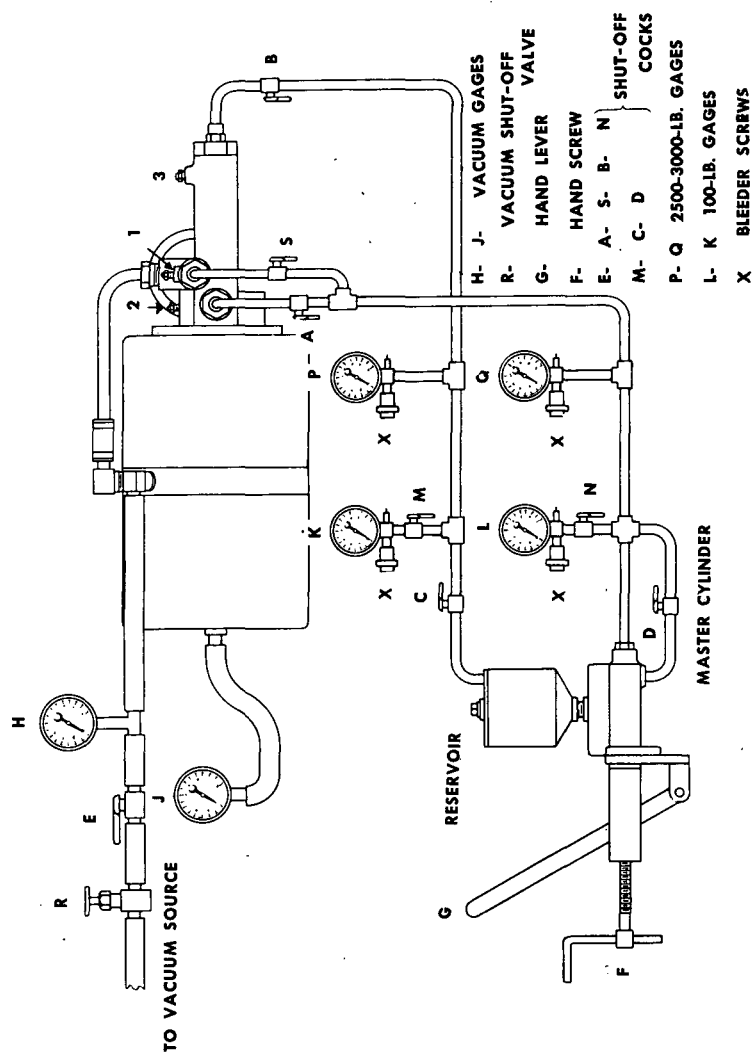


Figure 58— Test Bench Diagram

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(3) Place new gaskets on center plate (fig. 27), and install center plate and piston assembly in shell.

(4) Assemble the upper cylinder shell as shown (fig. 28). Line up cylinder shells and center plate with scribe marks which were made before disassembly.

(5) Install through bolts and clamps and tighten evenly. Slide vacuum hoses on their fittings, and tighten hose clamps.

21. BENCH TEST.

a. Preliminary Instructions.

(1) A bench testing unit can be built of miscellaneous parts and gages. Follow diagram (fig. 58) and text will cover complete test. Connect lines and gages as shown (fig. 58) and make certain that the fluid reservoir is filled with hydraulic brake fluid.

(2) Run master cylinder pressure screw "F" all the way out. Move master cylinder lever "G" through 8 or 10 complete strokes. This should completely fill the volume of the lines and Hydrovac slave cylinder with brake fluid. Close shut-off valve "C" and open bleeder valve No. 1. Pump the lever "G" until fluid appears at the bleeder valve, then close it. This eliminates the air in the Hydrovac jumper line. Also bleed bleeder valves Nos. 2 and 3 while pumping lever "G."

b. Low-pressure Leakage Test. Open hydraulic valves "N" and "D." Valve "M" may be open or closed depending on whether the reading is to be taken on gage "K" or "P." If the test specification on the chart below is more than 100 pounds, valve "M" should be closed and the reading taken on gage "P." Open vacuum valve "E" and adjust regulating valve "R" to obtain 20 inches of vacuum at both gages "H" and "J."

(1) LOW-PRESSURE OPERATION SPECIFICATIONS.

Cylinder Part No.	Hydraulic Gage—L*	Hydraulic Gage—K	Hydraulic Gage—P	Vacuum Gage—H	Vacuum Gage—J*
373000	60 to 90 lb	.....	60 to 105 lb	20 in.	19 to 19½ in.
373050	35 to 65 lb	35 to 80 lb	.....	20 in.	19 to 19½ in.
373100	25 to 65 lb	25 to 70 lb	.....	20 in.	19 to 19½ in.
373163	60 to 90 lb	.....	60 to 105 lb	20 in.	19 to 19½ in.
373330	35 to 65 lb	35 to 80 lb	.....	20 in.	19 to 19½ in.
373370	15 to 40 lb	15 to 55 lb	.....	20 in.	19 to 19½ in.
373390	35 to 60 lb	35 to 75 lb	.....	20 in.	19 to 19½ in.
372960	30 to 65 lb	35 to 80 lb	.....	20 in.	19 to 19½ in.
373200	15 to 40 lb	15 to 55 lb	.....	20 in.	19 to 19½ in.
372774	60 to 90 lb	.....	60 to 105 lb	20 in.	19 to 19½ in.

*NOTE: As hydraulic pressure (Gage "L") is increased to some point between the two values noted in the table, the reading of vacuum gage "J" should start to decrease and should continue to decrease as hydraulic pressure is increased. The Hydrovac unit is satisfactory in this test if the vacuum gage shows a reading of 19 to 19½ inches while the hydraulic pressure is anywhere between the two values noted in the table. (Key letters in headings refer to fig. 58).

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c. **High-pressure Operation Test** (fig. 50). Close hydraulic valves "M" and "N." Open valve "D." Open vacuum valve "E" and adjust vacuum reading on gages "H" and "J" to 20 inches by regulating valve "R." Turn pressure screw "F" down until the following specifications are registered on the gages.

(1) HIGH-PRESSURE OPERATION SPECIFICATIONS.

Cylinder Part No.	Hydraulic Gage—Q	Hydraulic Gage—P	Vacuum Gage—H	Vacuum Gage—J
373000	280 to 300 lb	1040 to 1100 lb	20 in.	0 in.
373050	175 to 195 lb	1425 to 1500 lb	20 in.	0 in.
373100	125 to 155 lb	1150 to 1220 lb	20 in.	0 in.
373163	280 to 300 lb	1150 to 1220 lb	20 in.	0 in.
373330	175 to 195 lb	790 to 830 lb	20 in.	0 in.
373370	90 to 110 lb	985 to 1045 lb	20 in.	0 in.
373390	110 to 130 lb	1010 to 1070 lb	20 in.	0 in.
372960	175 to 195 lb	1075 to 1130 lb	20 in.	0 in.
373200	90 to 110 lb	390 to 440 lb	20 in.	0 in.
372774	280 to 300 lb	640 to 700 lb	20 in.	0 in.

NOTE: Key letters in headings refer to figure 58.

d. **Release Test.** Back out pressure screw "F" all the way to the released position. Have valves "D," "M" and "N" open, and 20 inches of vacuum should be present at both gages "H" and "J." Turn pressure screw "F" in until 40 to 50 pounds pressure is registered on gage "L." Now back out pressure screw slowly until both vacuum gages "H" and "J" register the same amount of vacuum. At this point hydraulic gage "L" should indicate a pressure not less than the value specified in the following chart. Hydraulic gage "K" should show the same reading in each case, as gage "L." If gage "K" reads higher than gage "L" the unit is not releasing properly, probably because of friction or binding of internal parts of the vacuum portion.

(1) RELEASE SPECIFICATIONS.

Cylinder Part No.	Hydraulic Gage—L	Vacuum Gage—J	Vacuum Gage—H
373000	20 lb or more	20 in.	20 in.
373050	15 lb or more	20 in.	20 in.
373100	8 lb or more	20 in.	20 in.
371163	20 lb or more	20 in.	20 in.
373330	15 lb or more	20 in.	20 in.
373370	3 lb or more	20 in.	20 in.
373390	20 lb or more	20 in.	20 in.
372960	15 lb or more	20 in.	20 in.
373200	3 lb or more	20 in.	20 in.
372774	8 lb or more	20 in.	20 in.

e. Vacuum Leakage Test.

(1) Adjust regulating valve "R" to obtain 20 inches of vacuum. Back pressure screw "F" all the way out. Open vacuum valve "E" until available vacuum is registered on gages "H" and "J." Then

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close valve "E." Vacuum drop should not be more than one inch in 15 seconds.

(2) Open vacuum valve "E" and turn pressure screw "F" in until vacuum gage "J" reads zero. Close valve "E." Vacuum registered on gage "J" should not drop more than one inch in 15 seconds.

22. ON-VEHICLE TEST.

a. The Hydrovac may be tested by installing it in a vehicle. See paragraph 12.

CHAPTER 5

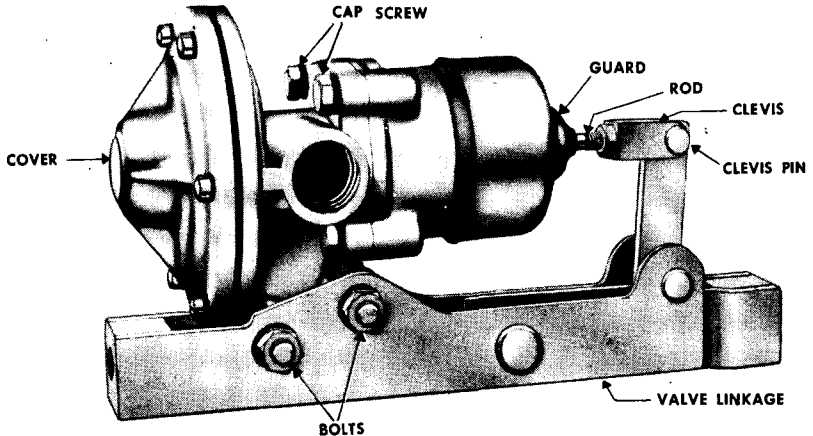
RXL VALVE

Section I

DESCRIPTION, OPERATION, AND DATA

23. DESCRIPTION.

a. The RXL valve is an external control valve which has a reactionary effect. It is mounted between the rods connecting the hydraulic master cylinder to the foot pedal linkage. Its purpose is to actuate and control the movement and force of the power cylinder which is connected to the hydraulic master cylinder. Manual brake system remains in operation in the event of power brake failure.



RA PD 312290

Figure 59—RXL Valve

b. The reactionary linkage and diaphragm make it possible to graduate the application of brakes to a fine degree of accuracy.

c. The RXL valve may be used on tractor-trailer combinations, giving control of trailer brakes.

24. OPERATION.

a. **Applied (fig. 60).** The valve is mounted on a carriage or framework, and is connected as a part of the foot pedal to master cylinder linkage. When the foot pedal is depressed, the linkage tends to push on the internal valve rod. The first movement of this rod during application will seat vacuum valve, closing off any further communication between ports "B" and "C." Continued movement of the valve rod lifts the atmospheric valve off its seat, allowing air from the air cleaner to enter the valve into port "C" and then through

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VACUUM BRAKE SYSTEMS (BENDIX B-K)

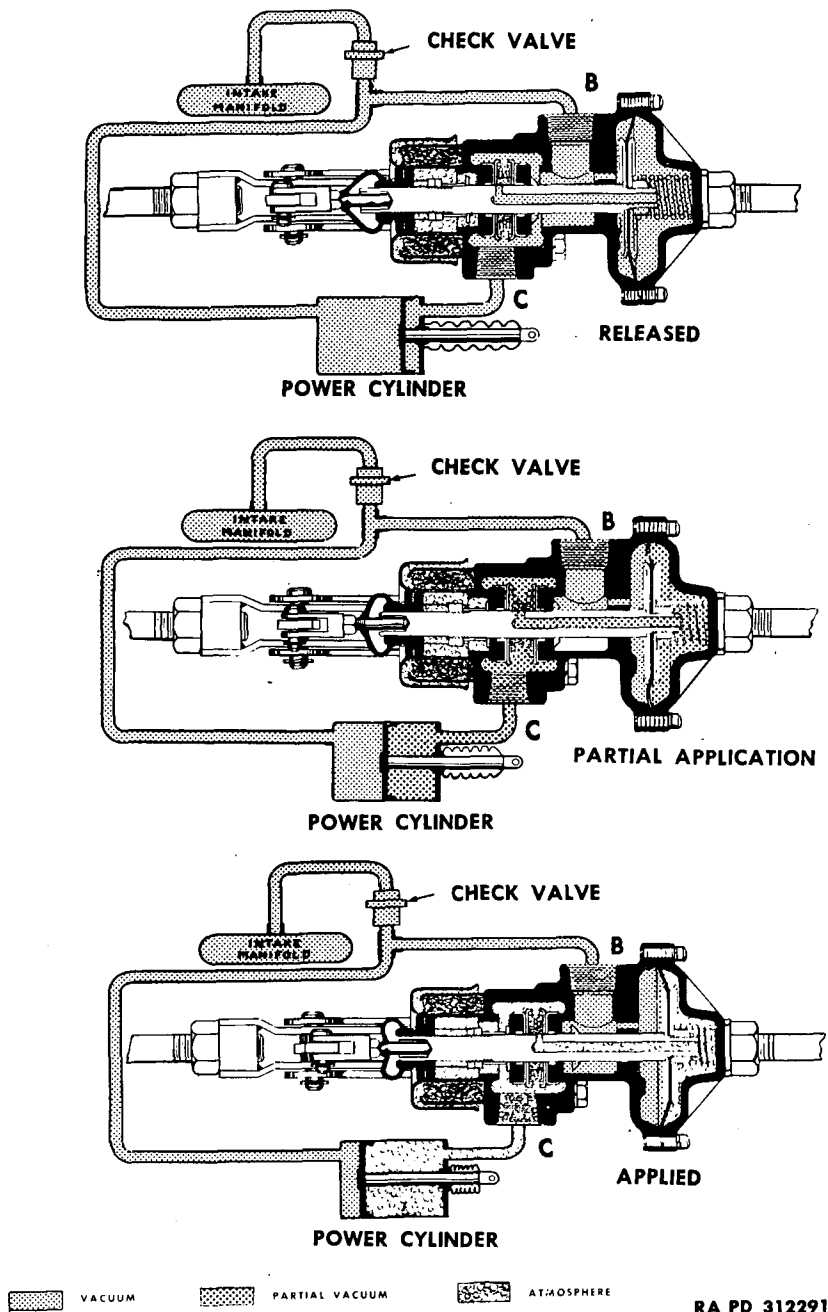


Figure 60—Sectional Views of RXL Valve—Released, Partially Applied, and Applied Positions

RXL VALVE

the line to the power unit. Port "C" is connected to the control side of the power unit. Air from the air cleaner is also admitted through a passage between vacuum valve and atmospheric valve, thence through the hollow shaft of the valve rod to the cover end of diaphragm chamber. As the vacuum at port "B" is connected through drilled channel in body to the body side of diaphragm, the air on the opposite side, together with the return spring, has a tendency to return the valve to the off position against the pressure of the driver's foot.

b. **Partial Application** (fig. 60). At one time during the sequence of operating from the released to applied, and from the applied to released positions, both valves are on their respective seats. This is called the holding position and is the position to which the valve returns whenever the driver stops the movement of his foot pedal during a partial brake application or release.

c. **Released** (fig. 60). When the driver removes all pressure from the foot pedal, the atmospheric valve is returned to its seat, shutting off further entrance of air from the air cleaner. The vacuum valve is lifted off its seat, and any air admitted to the system during application is drawn through port "B" to the intake manifold.

25. IDENTIFICATION DATA.

a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

b. **Identification Data.** The following table is supplied to assist in identification of models, and determining the repair kit to be used in repair of the unit.

Bendix Number	Ordinance Number	Model Number	Ratio	Repair Kit Bendix No.
370565	C-127152	RXL	2 1/4 to 1	370658
BK-21897	.....	RXL	3 to 1	370658

(Linkage ratio is stamped on the side of carrier bracket.)

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

26. DISASSEMBLY.

a. Remove the cotter pin from the clevis pin, and remove the clevis pin (fig. 59). Remove clevis and rod from the valve. **NOTE:** Do not loosen the clevis lock nut or remove the rod from the clevis. Remove the rubber guard. Remove the two bolts which hold the valve

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assembly to the linkage. Remove the six screws which hold the diaphragm cover in place. **CAUTION:** *Be careful that the cover does not spring out forcibly, due to pressure from a return spring which is under the cover.* Remove the lock ring and the air cleaner (fig. 61). Remove the four cap screws which hold the valve body sections together (fig. 59), and separate the body sections. Remove the two adjusting nuts (fig. 61) from the valve rod, and slide the valve disk assembly off the valve rod. Hold the valve rod in a vise and remove the nut (fig. 65) from the diaphragm end of the rod. Remove diaphragm assembly (fig. 64). Remove the valve rod from the valve body (fig. 63).

27. CLEANING, INSPECTION, AND REPAIR.

a. **Clean.** Clean all metal parts thoroughly in carburetor cleaning solution, and rinse in dry-cleaning solvent. Dry thoroughly with clean cloth. Blow out all passages with compressed air. Place parts on clean paper or cardboard.

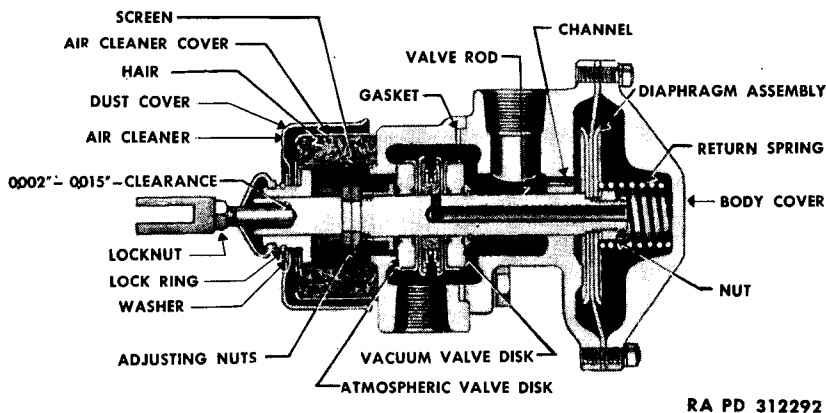


Figure 61—Cross-section of RXL Valve

b. **Inspect.** Inspect valve seats for smoothness. If scored or pitted, polish with fine steel wool. Blow out all dust from polishing operation. Inspect valve rod for smoothness. If scored or pitted, replace.

c. **Repair.** Using the proper repair kit for the model unit being repaired (par. 25), remove the contents of the carton and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective.

RXL VALVE

Section III

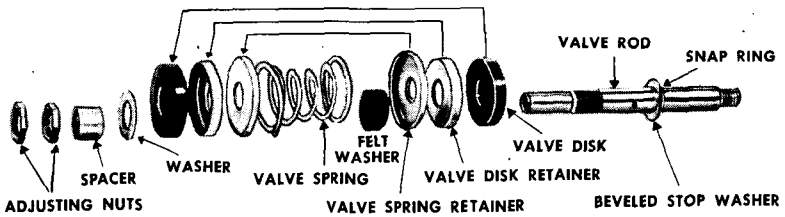
ASSEMBLY AND TEST

28. ASSEMBLY.

a. All parts in the repair kit should be installed when the valve has been disassembled for an overhaul. *NOTE: These parts are subject to wear which is difficult to detect by inspection; therefore, do not install an old part of questionable condition.*

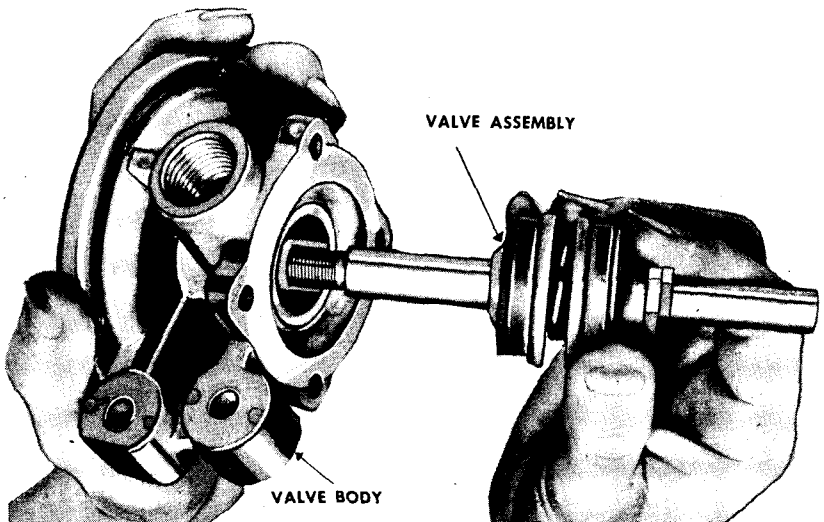
b. Valve Disk and Rod Assembly (figs. 62 and 63).

(1) Place the beveled stop washer against the snap ring on the valve rod, with beveled end of washer against the snap ring. Place



RA PD 312293

Figure 62—Valve Disk and Rod Assembly, Partially Disassembled



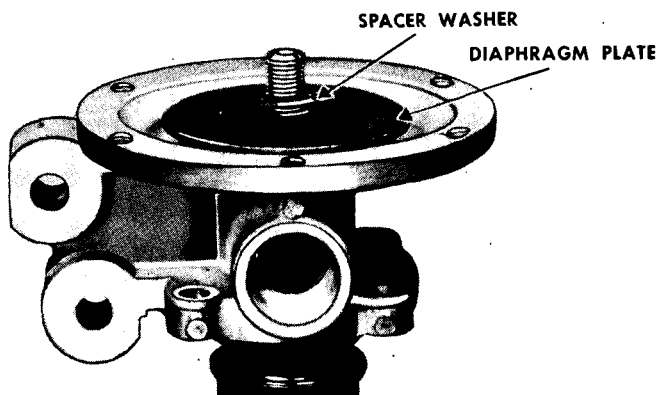
RA PD 312294

Figure 63—Installing Valve and Rod Assembly

**ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)**

the valve disk on the valve rod next to the beveled washer. **NOTE:** *Work valve disk carefully over valve rod threads to prevent cutting valve disk.* Place the valve disk retainer with its lip extending over the valve disk on the valve rod. Place the valve spring retainer on the rod with its lip facing away from the valve disk retainer. Saturate the felt washer with a graphite lubricant, and place on valve rod. Place valve spring over valve rod. Place valve spring retainer on valve rod with its lip facing spring. Place valve disk retainer on the rod. Place valve disk on the rod and in the valve disk retainer. **NOTE:** *Work valve disk carefully over valve rod threads to prevent cutting of valve disk.* Place flat washer and valve spacer on valve rod.

(2) Compress valve assembly and screw on the two valve adjusting nuts, but do not tighten.



RA PD 312295

Figure 64—Diaphragm Plate Assembly

(3) Insert the threaded end of valve rod in the diaphragm section of the valve body (fig. 63). Hold the unthreaded end of the valve rod in a vise with brass jaws.

c. Diaphragm Assembly. Assemble the diaphragm parts in the following order:

(1) Diaphragm plate with its rounded edge toward the diaphragm (fig. 64).

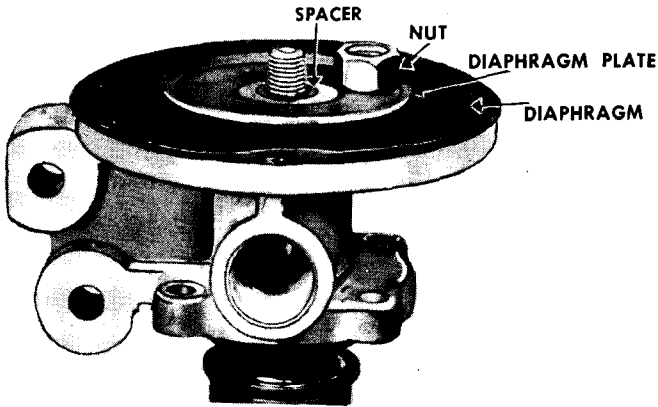
(2) The spacer washer (fig. 64).

(3) The diaphragm (fig. 65).

(4) The diaphragm plate with its rounded edge toward the diaphragm (fig. 65).

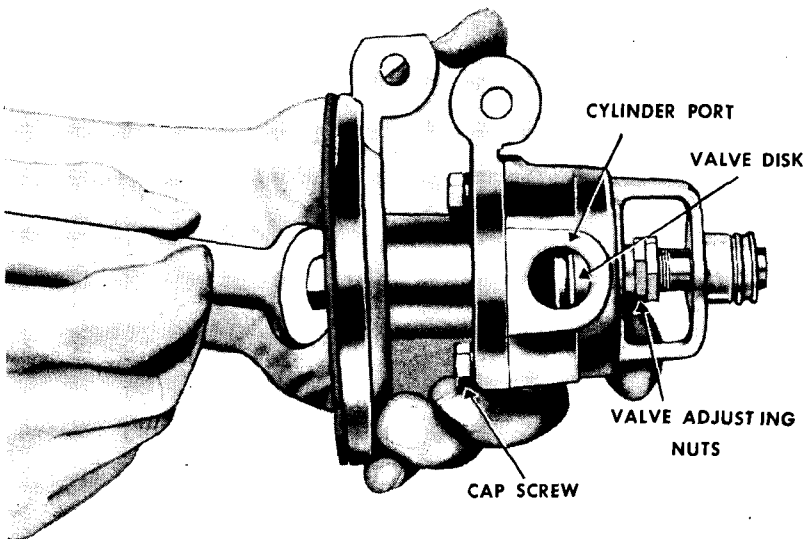
(5) Put sealing compound on threads and install nut (fig. 65). Remove assembly from vise. Install the gasket (fig. 61) in the air cleaner end of the valve body, and slide this body section upon the rod. Insert the four cap screws and tighten evenly (fig. 66).

RXL VALVE



RA PD 312296

Figure 65—Diaphragm Assembly



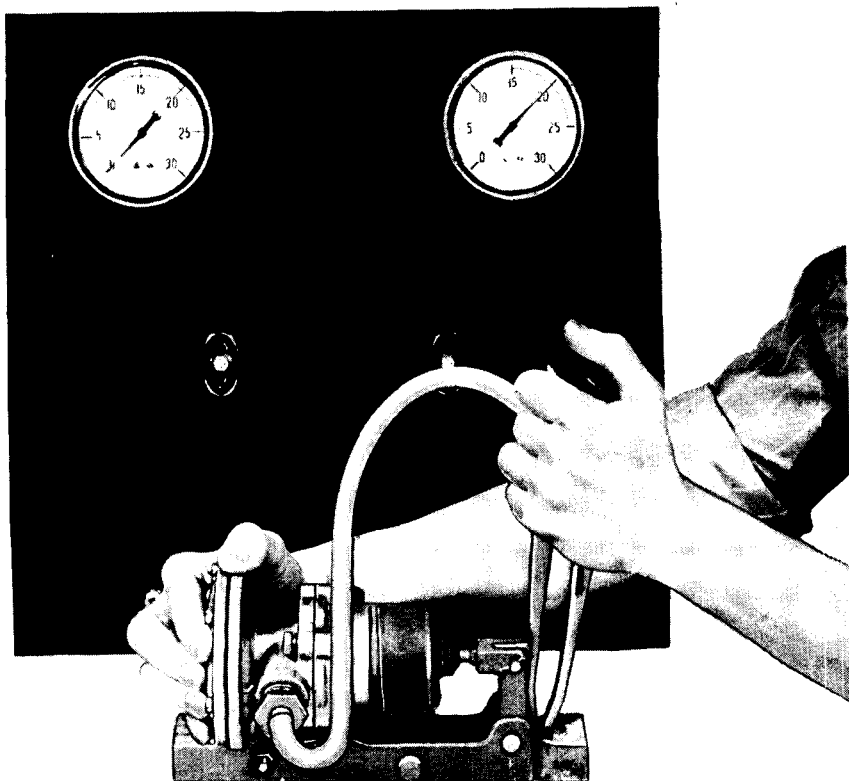
RA PD 312297

Figure 66—Adjusting Valve Disks

d. Preliminary Adjustment (fig. 66).

(1) Tighten the valve adjusting nuts with fingers until both valve disks are just clear of their seats. *NOTE: This point can be determined accurately by rotating the valve rod with an end wrench placed on the diaphragm nut and watching the valve disks through the cylinder port. At the point where the disks are just clear of the seats, they will start turning with the rod.*

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RA PD 312298

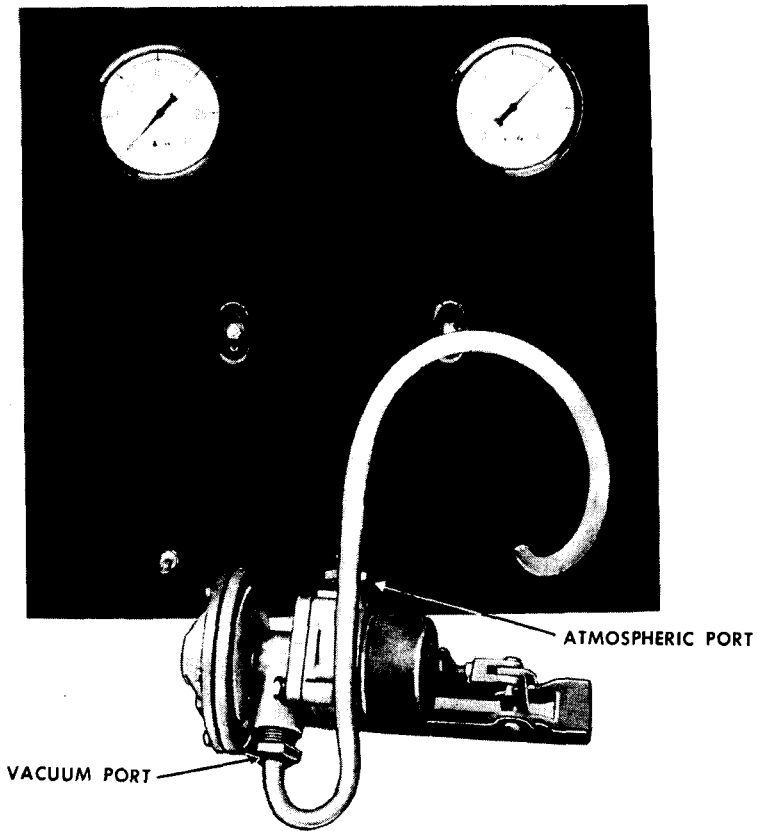
Figure 67—Checking Valve Travel

(2) Back off the adjusting nuts until the valve disks just contact their seats. *NOTE: As in the note in step (1) above, this point may be determined by noting the exact point where the disks stop turning with the rod.*

(3) Then back off the adjusting nuts exactly one-half turn to get the first setting for the valve.

(4) Fit the return spring over the end of the valve rod. Install the body cover, and tighten the six screws evenly (fig. 61).

e. **Air Cleaner Assembly** (fig. 61). Insert screen on air cleaner end of the body. Saturate the air cleaner hair in light engine oil and allow it to drain. Place air cleaner hair compactly around screen, and cover it with air cleaner cover. Place dust cover over air cleaner cover. Install washer and lock ring.

RXL VALVE

RA PD 312299

Figure 68—Testing Valves with Test Panel (BK-SER-452)**f. Final Assembly (fig. 59).**

(1) Lubricate all friction surfaces of the valve linkage assembly with a graphite lubricant.

(2) Place the valve in the linkage and insert the two bolts; place lock washer and nuts in position, but do not tighten. Insert the clevis rod through rubber guard, and then in the hole in the end of the valve rod. Aline the valve so that the holes in the clevis will line up with the hole in the linkage member to which the clevis attaches. Center line of valve should be parallel with center line of valve linkage carriage. Tighten the bolts with the valve in this position. Insert the clevis pin and cotter pin. Stretch rubber guard into groove.

g. Adjustment Procedure (fig. 67). Hold linkage firmly in the released position. Move linkage toward applied position, and note whether clevis rod comes within not less than 0.002 inch, and not

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more than 0.015 inch of bottoming in the hole in valve rod, as illustrated (fig. 61). If necessary, loosen the lock nut at the clevis and readjust to proper clearance. Place a pry in the linkage as illustrated (fig. 67), and measure the complete travel of valve rod. This movement should be $\frac{5}{16}$ inch. A shorter travel indicates valve is not opening completely. If impossible to arrive at this $\frac{5}{16}$ -inch movement, it may be due to worn linkage at clevis pin hole, necessitating replacement of worn linkage.

29. BENCH TEST.

a. **Released** (fig. 68). This test (made with test panel BK-SER-452) checks atmospheric valve body gasket and diaphragm. Seal atmospheric port with airtight plug or fitting, and connect vacuum port to vacuum. Turn vacuum on until gage registers maximum vacuum. Turn off vacuum. Vacuum loss should not be more than 1 inch in 15 seconds.

b. **Applied** (fig. 67). Pry the linkage to completely apply valve, and repeat above test to diaphragm and vacuum valves. With vacuum on, actuate valve off and then on, and note that it becomes progressively harder to hold valve open at fully applied position. This indicates the reaction of diaphragm against manual effort.

CHAPTER 6

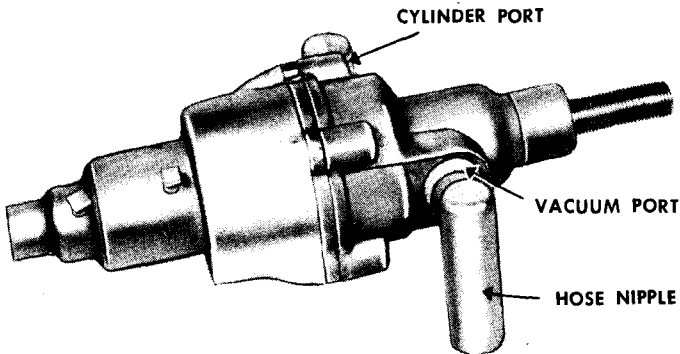
XT-1/2 VALVE

Section I

DESCRIPTION, OPERATION, AND DATA

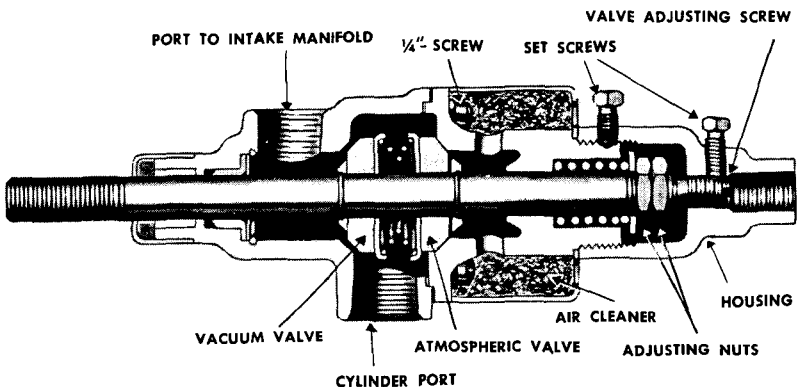
30. DESCRIPTION.

a. The XT-1/2 valve is an external control valve of the follow-up type. It is mounted in the rod attached to the foot pedal. Its purpose is to actuate and control the movement and force of the power cylinder which is connected to the lever at master cylinder. This valve is not reactionary, and controls the degree of brake through the follow-up of brake linkage caused by movement of the power cylinder. The XT-1/2 valve may be used on tractor-trailer combinations, giving control of trailer brakes.



RA PD 312300

Figure 69—XT-1/2 Valve



RA PD 312301

Figure 70—Sectional View of XT-1/2 Valve

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31. OPERATION.

a. **Applied** (fig. 70). This valve is mounted between the rods connecting the foot pedal and the master cylinder. When the foot pedal is depressed, the first movement of the forward section of pedal rod moves the vacuum valve onto its seat. Continued foot pedal movement then lifts the atmospheric valve from its seat, allowing air from the air cleaner into cylinder port, and thence into control line of the power cylinder, actuating the brakes.

b. **Released** (fig. 70). When foot pressure has been removed from the pedal, the atmospheric valve returns to its seat, sealing off further air from the air cleaner. The vacuum valve then leaves its seat, and all air admitted during brake application is withdrawn into the intake manifold.

c. **Partial Application** (fig. 70). In the holding position, or with brakes partly applied, both vacuum and atmospheric valves are on their respective seats, and power unit discontinues further movement.

32. IDENTIFICATION DATA.

a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

b. **Identification Data.** The following table is supplied to assist in identification of models and determining the repair kit to be used in repair of the unit.

Bendix Number	Ordance Number	Model Number	Repair Kit Bendix No.
BK-20187B	.....	XT-1/2	370647
BK-16393	B-264175	XT-1/2	370647
BK-17643	.....	XT-1/2	370647

Section II

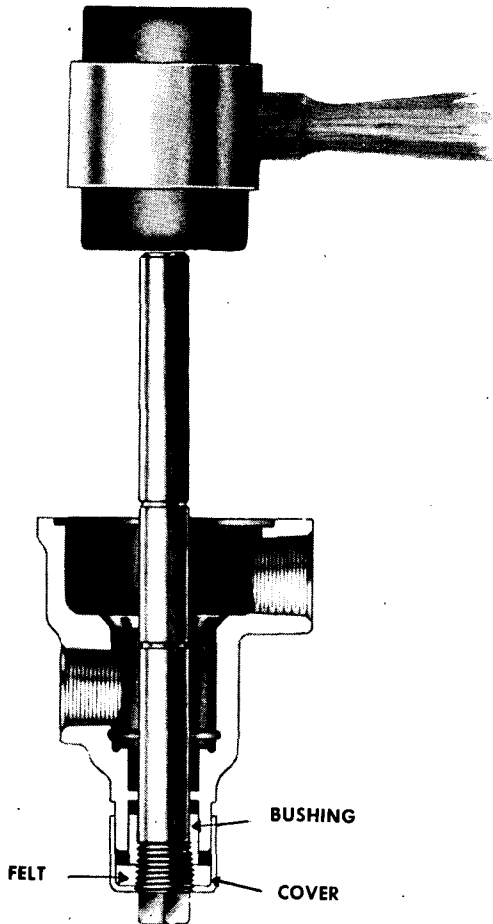
DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

33. DISASSEMBLY.

a. Remove the hose nipples (fig. 69).

b. Remove the set screw which is closest to the air cleaner, and remove valve housing end (fig. 70). Remove the air cleaner cover and hair. Remove the four 1/4-inch screws which hold the valve body sections together. Remove the port section of the body from the rod. Remove the two adjusting nuts from the spring end of the valve rod. Remove the rear body section from the valve rod.

XT-1/2 VALVE



RA PD 312302

Figure 71—Removing Bushing

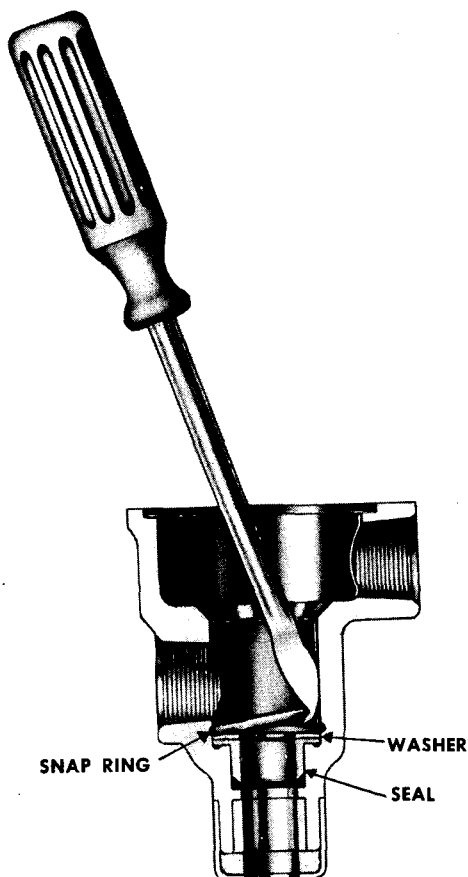
c. If front body section is to be rebushed, remove the felt retainer cover, felt, and bushing as illustrated (fig. 71). Tap bushing by screwing in a plug; drive out plug with drift or discarded valve rod, removing bushing.

d. Remove the valve rod leather seal (fig. 72). A convenient tool for removing the lock ring which holds this seal in place can be made by grinding a screwdriver to form a hook, as illustrated (fig. 72).

34. CLEANING, INSPECTION, AND REPAIR.

a. **Clean.** Clean all metal parts thoroughly in carburetor cleaning solution, and rinse in dry-cleaning solvent. Dry thoroughly with

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RA PD 312303

Figure 72—Removing Seal Assembly

clean cloth. Blow out all passages with compressed air. Place parts on clean paper or cardboard.

b. Inspect. Inspect valve seats for smoothness. If scored or pitted, polish with fine steel wool (grade 00). Blow out all dust from polishing operation. Inspect valve rod for smoothness. If scored or pitted, replace.

c. Repair. Using the proper repair kit for the model unit being repaired (par. 32), remove the contents of the carton and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective.

XT-1/2 VALVE

Section III

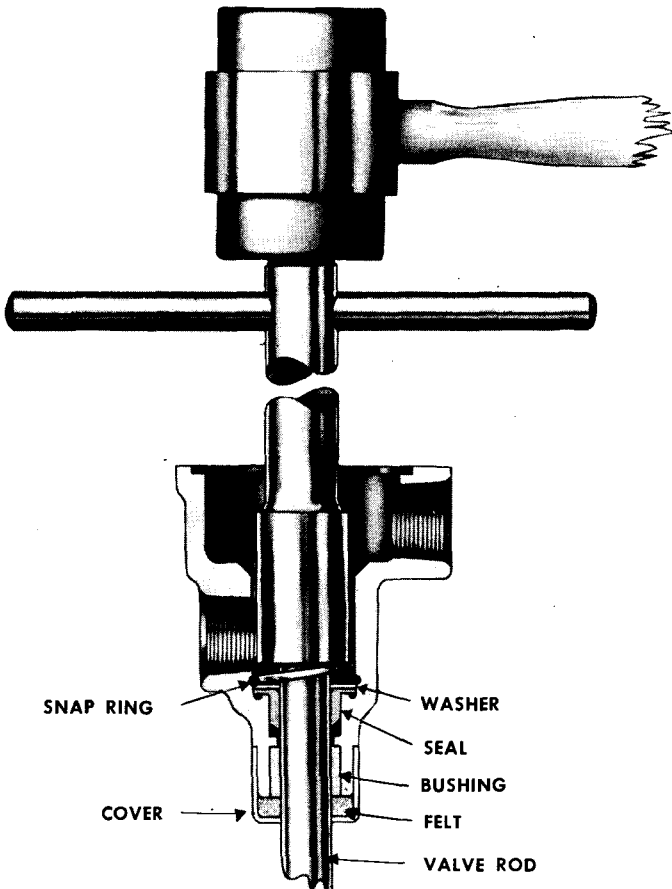
ASSEMBLY AND TEST

35. ASSEMBLY.

a. **General.** All parts in the repair kit should be installed when valve has been disassembled for an overhaul. These parts are subject to wear which is difficult to detect by inspection.

b. **Install Bushing** (fig. 71). Install the front body section bushing and ream it to fit rod. *NOTE: In most cases reaming will not be necessary.* Install a new felt and felt retainer.

c. **Install Seal.** Dip the new leather seal in light shock absorber fluid, and with the valve rod temporarily placed in the body section



RA PD 312304

Figure 73—Installing Seal

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to act as a guide, install the leather seal, the steel washer, and the snap ring. Be sure the steel washer is centered and does not bind rod. Install the snap ring, using socket wrench as illustrated in figure 73, or a piece of pipe of proper diameter.

d. Install Valve Rod and Disks.

(1) Use the tips of the fingers and work a small amount of water pump grease into the cork valve disks, and then wipe dry with a cloth.

(2) Install the end of the valve rod which has the shorter length of threads into the air cleaner section of the valve body (fig. 70). Place a small amount of water pump grease on the gasket; install the gasket, and then install and tighten the four $\frac{1}{4}$ -inch cap screws evenly and securely.

(3) Rotate the valve rod in the body, and watch the valve disks through the cylinder port. Both disks should remain seated; this will be indicated by the fact that neither disk will turn with the rod.



RA PD 312305

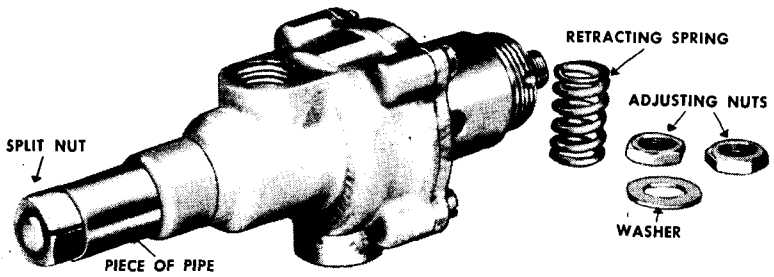
Figure 74—Refacing Valve Disk

(4) If both valve disks turn with the rod, there is too little overlap; disassemble the valve again, and remove the valve disks from the rod. Using fine abrasive cloth on a flat surface as illustrated (fig. 74), remove a small amount of stock from the flat faces of each valve disk on the beveled side. This allows the disks to fit closer to the seats, and serves to increase the overlap of the valves. Be careful not to remove too much stock from the surface of the disks or the overlap will be too great.

e. Preliminary Adjustment.

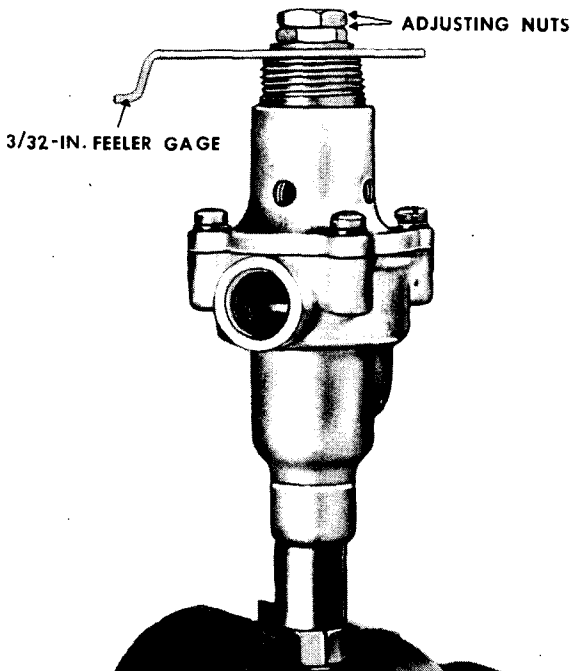
(1) Before installing the retracting spring on the air cleaner end of the valve rod, place a piece of pipe with a loose fit over the front end of the rod, and screw on a $\frac{1}{2}$ -inch SAE nut which has been sawed through one corner to form a clamp. This nut should be drawn up only to the point where the collar cannot be rotated easily with

XT-1/2 VALVE



RA PD 312306

Figure 75—Pipe Installed on Valve Rod



RA PD 312307

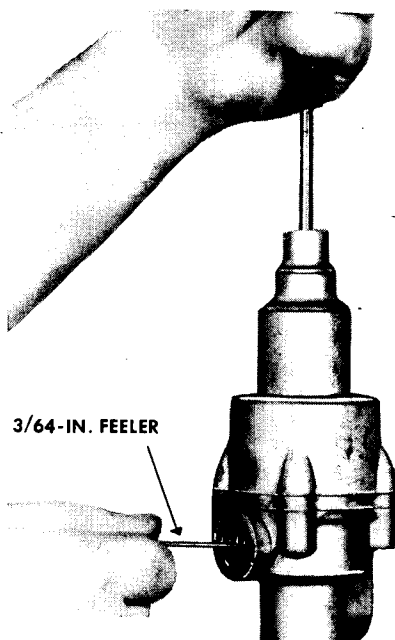
Figure 76—Making Preliminary Valve Adjustment

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the fingers. It must not be tightened to the point of actuating the valve disks. Clamp the split nut in a vise (fig. 76); the saw cut will allow the nut to hold the valve rod securely.

(2) Install the spring (fig. 75), the flat washer, and the two thin nuts on the air cleaner end of the valve rod in the order named.

(3) Turn the two adjusting nuts (fig. 76) down until the distance between the inner face of the flat washer and end of the valve housing is exactly $\frac{3}{32}$ inch. Prepare and use a $\frac{3}{64}$ -inch feeler gage for checking the adjustment. When this adjustment has been made, lock or jam the two nuts together securely; then check the clearance again to be sure it has not changed.



RA PD 312308

Figure 77—Making Final Valve Adjustment

f. Final Assembly (fig. 70).

(1) Saturate the new hair for the air cleaner in light oil and allow it to drain. Place the hair in the cover, and install the cover assembly on the valve body. Then screw the valve housing end up on the valve body, seating it tight enough to hold the air cleaner cover securely in place.

(2) At this point the set screw hole in the valve housing end should line up with the countersink in the body section. If it does not, drill a new countersink the same depth as the one originally used. Do not tighten the set screw against the threads without drilling a

XT-1/2 VALVE

countersink; this would damage the threads and make later disassembly difficult.

g. Adjustment Procedure.

(1) With a $\frac{3}{64}$ -inch feeler gage, reach through the cylinder port and check the clearance between the vacuum valve disk and its seat; do not force the feeler gage into this opening, since this will not give a correct measurement and will damage the cork disk.

(2) If it is necessary to set the vacuum valve clearance, loosen the set screw (fig. 70) which locks the vacuum valve adjusting screw in place and turn the adjusting screw (fig. 77) which is reached through the hole in the rear end of the valve, until a clearance of exactly $\frac{3}{64}$ inch is obtained between the valve disk and the seat.

36. BENCH TEST.

a. Released (fig. 69). Connect a vacuum line to the vacuum port of the valve. Using test panel (BK-GER-452), place an airtight plug in the cylinder port. Open the valve until the gage shows its maximum vacuum. Close the valve; if the vacuum drop does not exceed 3 inches of mercury in 15 seconds, the valve tests satisfactorily in the released position.

b. Applied. With valve still connected to vacuum, place the piece of pipe (fig. 75) over the end of the rod, and draw it down with a nut as far as it will go. This will bring the valve to the applied position. Repeat the vacuum test. Again the vacuum drop should not exceed 3 inches of mercury in 15 seconds.

ORDNANCE MAINTENANCE
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CHAPTER 7

RH HAND VALVE

Section I

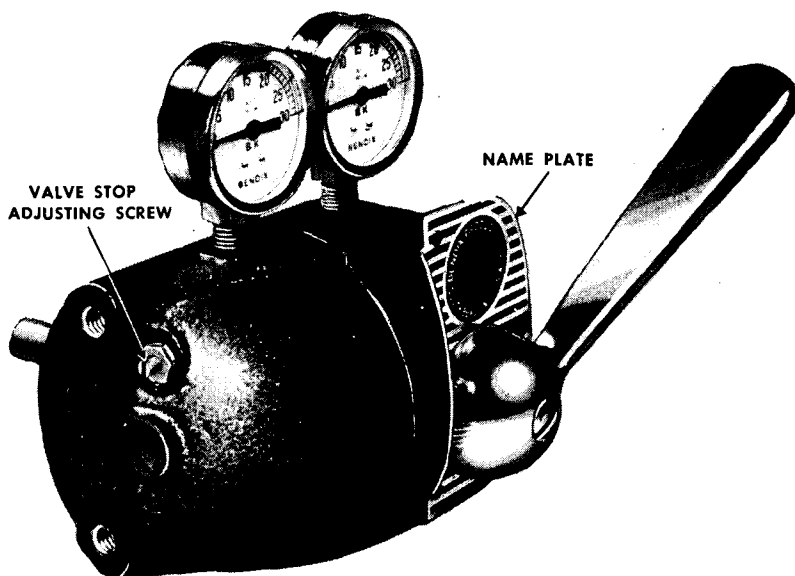
DESCRIPTION, OPERATION, AND DATA

37. DESCRIPTION.

a. The RH hand valve (fig. 78) is an external control valve used in operating the vacuum brake system on a trailer. It is mounted on the steering column or dash of a towing vehicle, and is connected by tubing or hose to the trailer brake system. It is a hand control valve and is designed to apply trailer brakes gradually. The piping from this valve is to the left-hand control line of the trailer system.

38. OPERATION.

a. Applied (fig. 79). When the hand lever is turned to the applied position the vacuum valve closes, shutting off further communication between control line and the intake manifold. The atmospheric valve is opened, allowing air from air cleaner to enter through the hollow valve sleeve and into the control line to the trailer brakes. This air entering the control line operates the trailer system.



RA PD 312309

Figure 78—RH Hand Valve with Gage (41-G-500) Installed

RH HAND VALVE

RA PD 312310

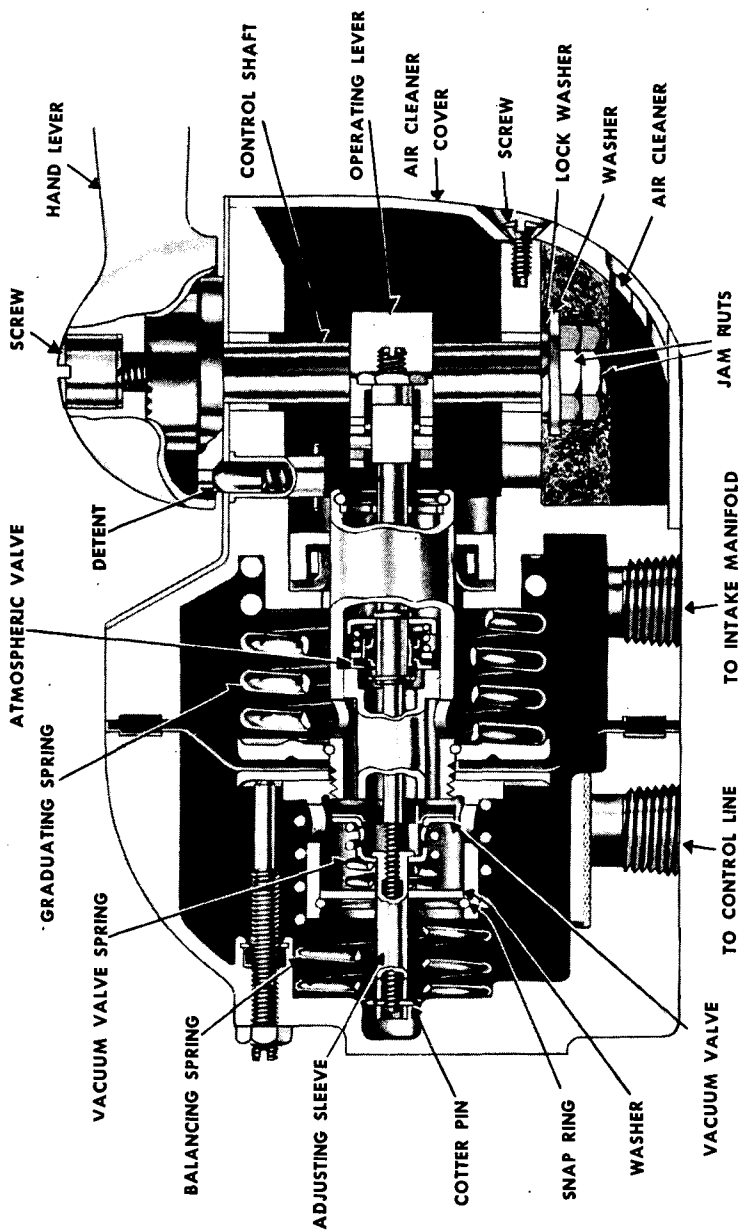


Figure 79—Sectional View of RH Hand Valve

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b. **Released.** When the hand lever is returned to the off position the atmospheric valve returns to its seat, preventing further entry of air. The vacuum valve leaves its seat, permitting the air admitted during application to be drawn into the intake manifold, which in turn balances the system in vacuum, allowing the release of the brakes.

c. **Partial.** In the holding position, or with brakes partially applied, the diaphragm, through balancing at internal pressures, will rest with both vacuum and atmospheric valves on their respective seats, holding the brake system in the attained position.

39. IDENTIFICATION DATA.

a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a like vehicle.

b. **Identification Data.** The following table is supplied to assist in identification of models, and determining the repair kit to be used in repair of the unit.

Bendix Number	Model Number	Repair Kit Bendix No.
370181	RH	371444
373232	RH	371444

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

40. DISASSEMBLY.

a. Remove the hose nipples and clean externally.

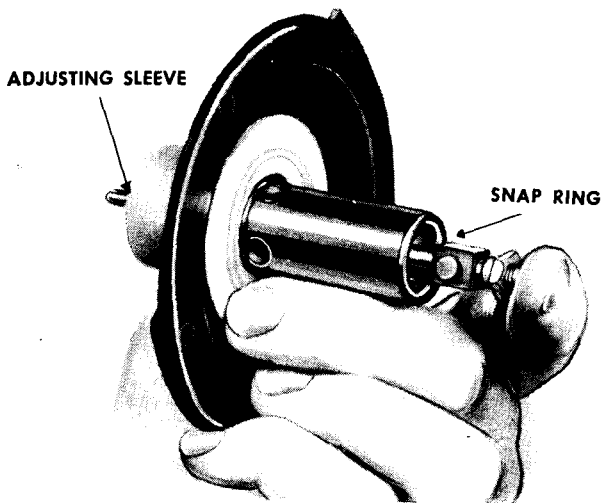
b. Remove the screw (fig. 79) in the hand lever. Remove the screw which holds the air cleaner cover to the main body. Remove the name plate (fig. 78), the hand lever, and the control shaft (fig. 79). Disassemble the detent from the valve body. Remove the five screws which hold the body sections together (fig. 88), and separate bodies. *NOTE: The diaphragm, which also acts as a gasket between the two body sections, sometimes sticks to the body sections. If this occurs, carefully pry the two body sections apart with a thin knife blade.* Remove the adjusting sleeve and diaphragm assembly (fig. 80) from the body section.

RH HAND VALVE

c. Remove the snap ring from each end of the diaphragm and adjusting sleeve assembly (figs. 80 and 81).

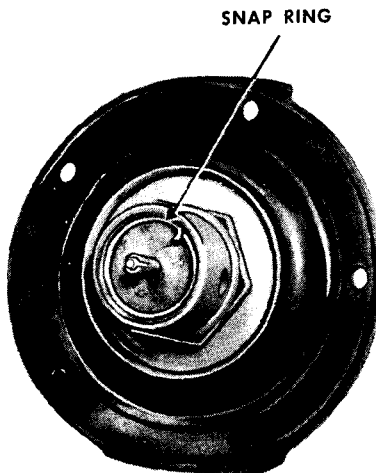
d. Remove the cotter pin which locks the adjusting sleeve (fig. 79). Remove the washer, vacuum valve spring, and vacuum valve from the large end of the assembly.

e. Remove the atmospheric valve and stem assembly (fig. 82) from the diaphragm and sleeve assembly. Remove the nut and trunnion from the end of the stem. Remove the cotter pin, spring retainer, spring, atmospheric valve disk, and washer.



RA PD 312311

Figure 80—Making Internal Adjustment



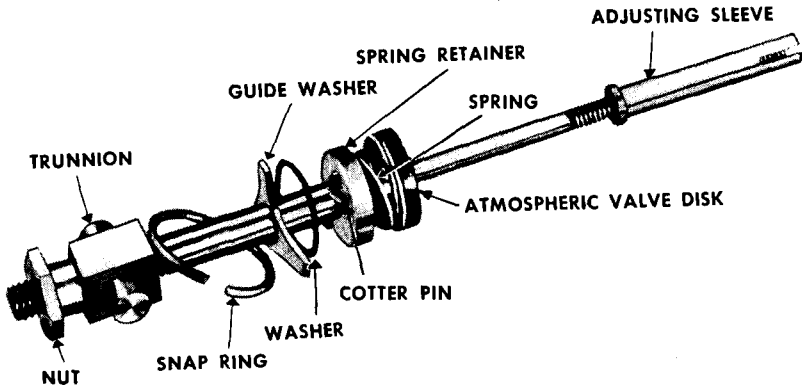
RA PD 312312

Figure 81—Adjusting Sleeve

**ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)**

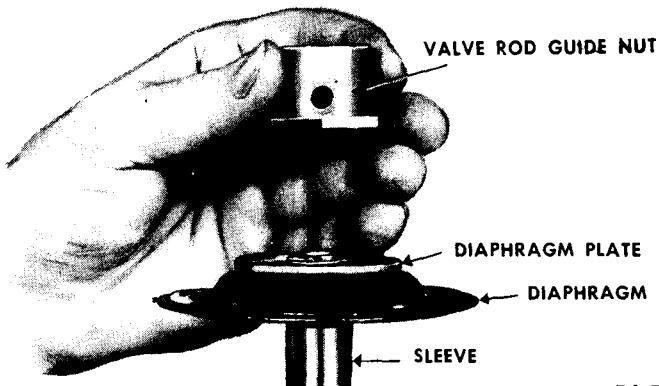
f. Hold the sleeve in a vise with brass jaws. Apply a wrench to the hexagon portion of the valve rod guide nut (fig. 83), and remove this nut from the assembly. Remove diaphragm and both diaphragm plates.

g. Remove piston rod guide bushing and seal assembly (fig. 84) by turning bolt to draw plug and seal from valve body.



RA PD 312313

Figure 82—Atmospheric Valve and Stem Assembly



RA PD 312314

Figure 83—Diaphragm Assembly

41. CLEANING, INSPECTION, AND REPAIR.

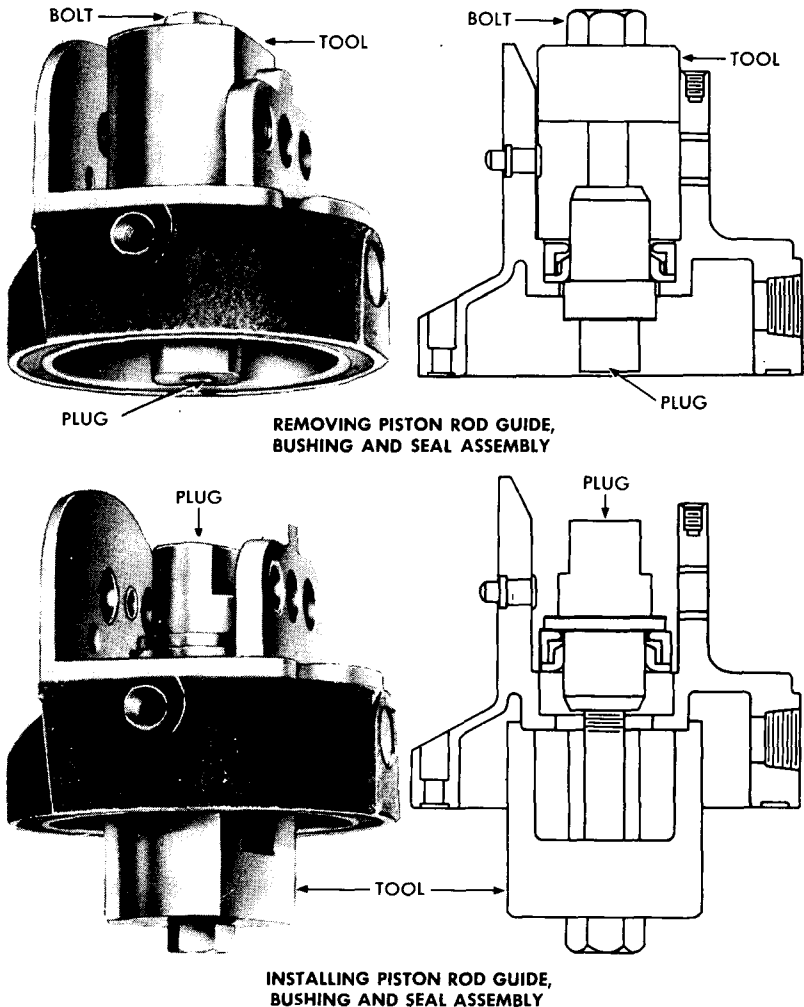
a. **Clean.** Clean all metal parts thoroughly with carburetor cleaning solution, and rinse in dry-cleaning solvent. Dry thoroughly with clean cloth. Blow out all passages with compressed air. Place parts on clean paper or cardboard.

b. **Inspect.** Inspect valve seats for smoothness. If scored or pitted, polish with fine steel wool (grade 00). Blow out all dust from polish-

RH HAND VALVE

ing operation. Inspect valve rod for smoothness. If scored or pitted, replace.

c. **Repair.** Using the proper repair kit for the model unit being repaired (par. 39), remove the contents of the carton, and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective.

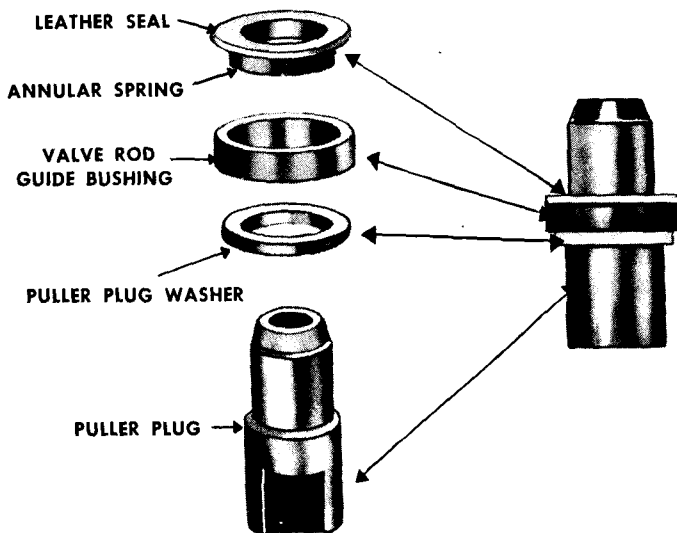


RA PD 312315

Figure 84—Installing Piston Rod Guide, Bushing, and Seal Assembly

**ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)****Section III****ASSEMBLY AND TEST****42. ASSEMBLY.**

a. **Install Seal** (fig. 85). Place annular spring over lip of leather seal, and place this assembly in valve rod guide or retainer ring. Place these parts over male section of puller plug on top of puller plug washer. Insert the tool and assembly into casting as illustrated in figure 84. Place main body of puller in open end of casting, and tighten puller bolt until seal assembly bottoms. Remove puller.



RA PD 312316

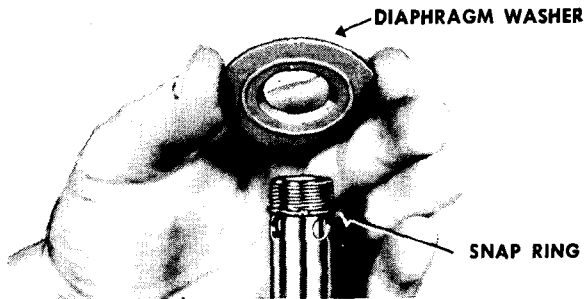
Figure 85—Seal Assembly on Tool

b. **Assemble Diaphragm.** Hold the valve sleeve in a vise with brass jaws. Place the large grooved washer on the valve sleeve with the wider opening over snap ring (fig. 86). Place the diaphragm in position with the concave side down (fig. 83). Apply a thin coat of shellac or sealing compound around the threads on the valve sleeve. Place the other diaphragm plate in position with the rounded edge toward the diaphragm (fig. 83). Screw on the valve rod guide nut and tighten firmly, but do not pull down tight enough to distort the diaphragm.

c. **Assemble Internal Valve** (fig. 82). Assemble the parts on the larger diameter of the valve stem (fig. 82) in the following order:

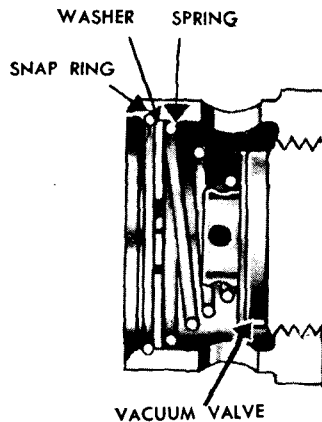
RH HAND VALVE

- (1) The atmospheric valve disk.
- (2) Flat washer.
- (3) Spring.
- (4) The valve spring retainer.
- (5) Install cotter pin so it will not bind on the sides of the valve sleeve.



RA PD 312317

Figure 86—Installing Diaphragm Washer



RA PD 312318

Figure 87—Sectional View of Vacuum Valve Assembly

- (6) Thin flat washer.
- (7) Three-pointed guide washer.
- (8) Install the trunnion and the trunnion lock nut. One end of the trunnion threads is undercut; this end should go toward the valve. The lock nut should be installed with the hexagon end away from the trunnion.

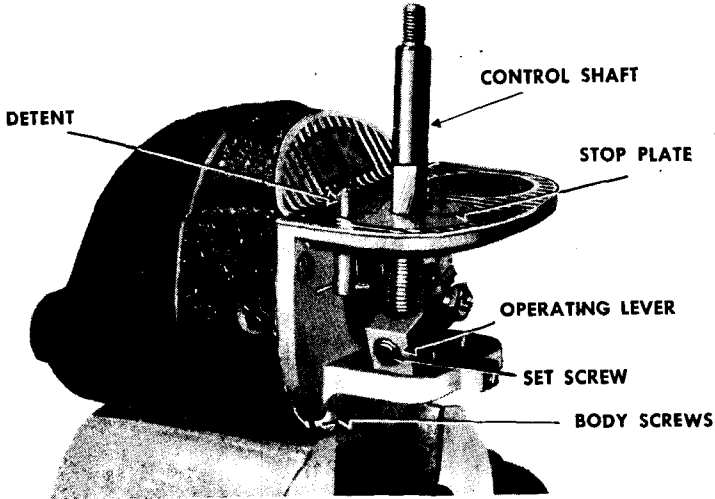
d. **Install Valve Assembly.** Place this assembly in the adjusting sleeve (fig. 80), and install the snap ring.

ORDNANCE MAINTENANCE VACUUM BRAKE SYSTEMS (BENDIX B-K)

e. **Assemble Vacuum Valve** (fig. 87). Install the vacuum valve parts in the following order:

- (1) Vacuum valve.
- (2) Valve spring.
- (3) Steel washer.
- (4) Snap ring.

f. **Preliminary Adjustment** (fig. 80). Adjust the adjusting sleeve on the diaphragm assembly; screw in adjusting sleeve until end of sleeve is at cotter pin hole. With fingers on valve rod, compress atmospheric valve spring slightly. Continue this finger movement at about two movements per second, and with other hand screw out on adjusting sleeve until shoulder of sleeve contacts vacuum valve (fig. 79); this will be felt by the finger that is actuating valve rod, as



RA PD 312319

Figure 88—Stop Plate Washer Assembly

atmospheric valve spring will now be harder to compress. When this position is determined, screw the adjusting sleeve back in about one turn. The pick-up of vacuum valve should occur between 0.005 and 0.015-inch movement of valve rod which is still being actuated with finger. Install cotter pin to lock sleeve at point attained favoring the 0.015-inch play.

g. **Assemble Components.**

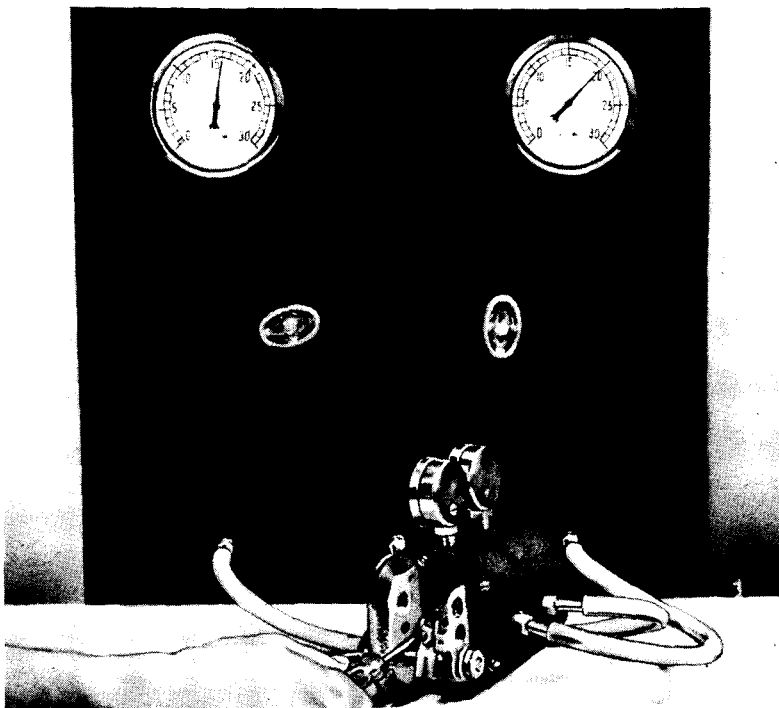
(1) Install the large graduating spring (fig. 79) in the body. Place the diaphragm and sleeve assembly in the body section; be certain that the diaphragm is placed so that the outer edges fit the shape of the body section.

RH HAND VALVE

(2) Put the balancing spring in position, and install the other body section. Be certain that the spring rests squarely in the recess in the body casting. Tighten the five screws evenly (fig. 88).

h. Assemble Control Shaft and Lever.

(1) Lubricate the detent with a graphite lubricant and assemble the parts as follows (fig. 79): cotter pin, detent spring, and detent. Install the stop plate washer over detent with small notch at the control stop, with the large notch aligned with the detent (fig. 88).



RA PD 312320

Figure 89—Making Final Adjustment and Test with Test Panel (BX-SER-452)

(2) Lubricate the control shaft with light shock absorber fluid, and insert it through the upper bushing, through the operating lever, and then through the lower bushing. Install the lock washer which serves as a spring, the flat washer, and the two nuts (fig. 79). The nuts are to be given final adjustment after the hand lever is installed.

(3) Install a set screw to lock the operating lever to control shaft, the set screw contacting the flat on the control shaft; it is important for the operating lever and poppet valve stem to be in alignment (fig. 88). Attach the name plate (fig. 78).

(4) Install the hand lever (fig. 79). Adjust the jam nuts on the

**ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)**

end of the control shaft so that $1\frac{1}{2}$ - to 2-pounds force exerted at the end of the hand lever will move the lever through its arc of travel. Lock jam nuts. Position hand lever so that when half through its travel lever will be parallel with center line of valve.

i. Adjustment Procedure.

(1) Screw out valve stop adjusting screw (fig. 78) four turns; place finger over sleeve on opposite end. Screw in valve stop adjusting screw until the contact of stop can be felt against diaphragm plate. Turn stop screw in one more full turn which will move diaphragm assembly and sleeve toward hand lever end about $\frac{1}{32}$ inch.

(2) Connect vacuum port of valve to a vacuum source as illustrated in figure 89. NOTE: *Vacuum port is stamped "VAC."* With the right-hand test panel valve remaining open, the vacuum on both gages should be exactly 20 inches. It may be necessary to bleed the source vacuum to bring the vacuum to this exact reading. Place the valve control handle in the first detent from the fully released position.

(3) Screw in or out on the valve shaft (fig. 89) until the left-hand panel gage drops to 16 inches of vacuum.

43. BENCH TEST.

a. Use test panel (B5-SER-45). Turn valve handle to off position. Connect one gage of panel to vacuum port and one gage to cylinder port. Turn on vacuum to vacuum port, leaving other gage connected to cylinder port (fig. 89). Both gages should read 20 inches vacuum. Turn off vacuum. Vacuum should not drop more than 2 inches in 15 seconds. Repeat with handle in the on position; gage connected to cylinder port should be at 0 inch vacuum and other gage at 20 inches vacuum. Drop in vacuum should not be more than 2 inches in 15 seconds.

b. With vacuum turned on at vacuum port, actuate handle through its stroke, observing gage connected to cylinder port, which should rise and fall from 0 to 20 inches vacuum during operation.

CHAPTER 8

CONVERSION VALVE

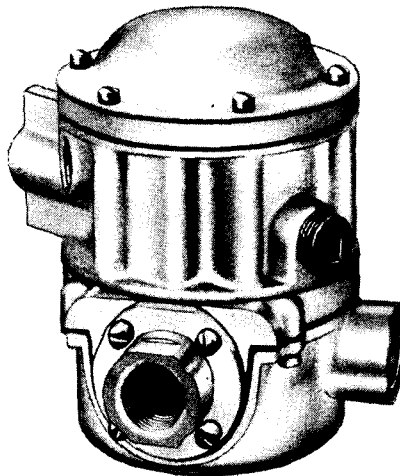
Section I

DESCRIPTION, OPERATION, AND DATA

44. DESCRIPTION.

a. The conversion valve is a remote control (relay) valve for operation of trailer brakes in approximate synchronization with brakes of towing vehicle. The unit is mounted close to the power units of trailer axle.

b. This valve converts from the vacuum-suspended to the air-suspended system, thereby controlling atmospheric-suspended units with the vacuum-suspended controls of towing vehicle.



RA PD 312321

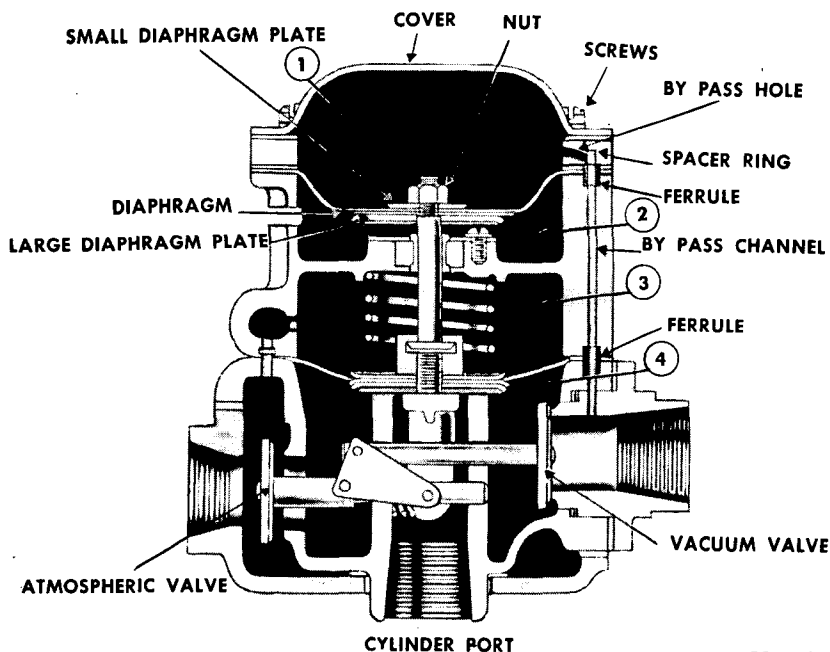
Figure 90—PC Conversion Valve

45. OPERATION.

a. **Released.** With trailer connected to towing vehicle and engine running, a vacuum is created in the top chamber via a by-pass channel which is connected to vacuum port. The second chamber is also connected to vacuum in left control line of towing vehicle. Chambers Nos. 3 and 4 are open to atmosphere at air cleaner. Top diaphragm is balanced in vacuum, and bottom diaphragm is balanced in atmosphere. Valve spring holds diaphragm down, which in turn holds vacuum valve closed and air valve open. In this position, there is no vacuum in power units on axle, with brakes off.

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b. Applied. When brakes of towing vehicle are applied, the vacuum in the left control line is depleted; as this line is connected to chamber No. 2, air rushes in under diaphragm, moving it up toward the vacuum side. Linkage connected to diaphragm moves atmospheric valve to its seat, sealing off the valve from air cleaner. Vacuum valve then leaves its seat, and vacuum from the reserve tank is connected directly to the power units through the bottom port.



RA PD 312322

Figure 91—Sectional View of PC Conversion Valve

c. Partially Applied. Control of degree of application is in direct proportion to tractor application. If vacuum in chamber No. 2 is only partially depleted, the diaphragm moves up until atmospheric valve is closed and vacuum valve opens. When the vacuum builds up in power units, it also builds up in chamber No. 4, and as air is always present in chamber No. 3, the air holds back upward movement of diaphragm at a balancing position.

46. IDENTIFICATION DATA.

a. Identification Tags. Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

CONVERSION VALVE

b. **Identification Data.** The following table is supplied to assist in identification of models and determining the repair kit to be used in repair of the unit.

Bendix Number	Ordnance Number	Model Number	REPAIR KITS	
			Bendix No.	Ordnance No.
BK19145	.....	P.C.	370659	A304232
373230	C-127213	S.P.C.	370659	A304232

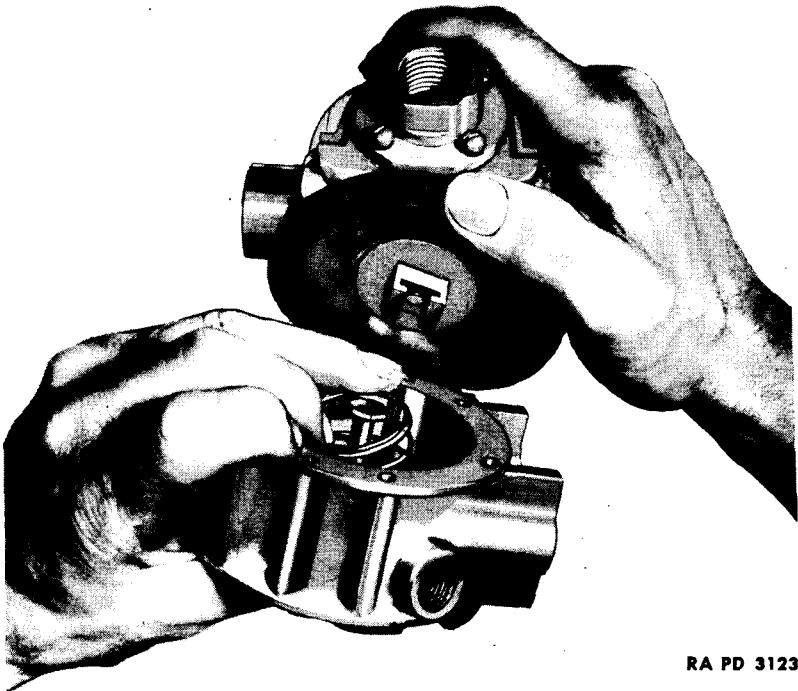
Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

47. DISASSEMBLY.

- a. **Preliminary Instructions.** Clean valve externally.
- b. **Disassemble Control Valve.**

(1) Remove the long screws which hold the two body sections together (fig. 91). Remove the top cover. Separate the upper and lower body sections, slipping the T-slot connection apart as illustrated in figure 92, and remove the release spring.



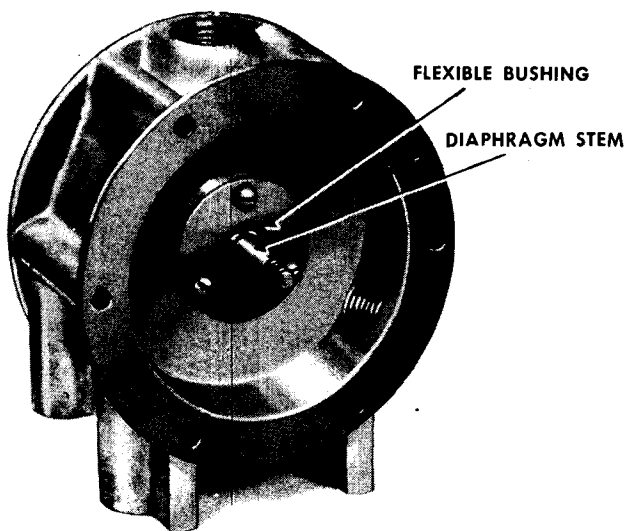
RA PD 312323

Figure 92—Separating Bodies

**ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)**

(2) Follow procedure in paragraph 8 h to disassemble control valve.

(3) Hold one end of the upper diaphragm rod; remove the nut, and remove the stem from the body section (fig. 93). Remove the three screws and the flexibly mounted bushing from the upper body section (fig. 93).



RA PD 312324

Figure 93—Flexible Bushing

48. CLEANING, INSPECTION, AND REPAIR.

a. **Clean.** Clean all metal parts in carburetor cleaning solution and rinse in dry-cleaning solvent.

b. **Inspect.** Inspect valve seats and remove corrosion or slight scratches with fine steel wool. Remove burrs or nicks on gasket surfaces with fine mill file. Blow out all passages with compressed air.

c. **Repair.** Using the proper repair kit for the model unit being repaired (par. 46), remove the contents of the carton and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective.

CONVERSION VALVE

Section III

ASSEMBLY AND TEST

49. ASSEMBLY.

a. Install the new flexibly mounted bushing assembly in the middle body housing, and tighten the three screws evenly. Place the diaphragm stem through center body section from side opposite screw heads (fig. 93).

b. Assemble upper diaphragm on stem as follows (fig. 91) on all conversion valves except "SPC" valves. On "SPC" valves, reverse order of diaphragm plates steps (2) and (6).

(1) Small metal stop washer.

(2) Small metal diaphragm plate (rounded edge toward diaphragm).

(3) Fabric spacer.

(4) Diaphragm.

(5) Fabric spacer.

(6) Large metal diaphragm plate (rounded edge toward diaphragm).

(7) With a small amount of sealing compound on threads, install and tighten the nut.

c. Install the atmospheric valve, spring and horseshoe lock washer with groove in valve stem upward. Install the vacuum valve part way into the guide with groove in valve stem downward. Assemble the new diaphragm and the link assembly into the notches in the valve stem (fig. 15). Thoroughly lubricate the linkage and all bearing points inside the valve with a graphite lubricant. **CAUTION:** *Do not get lubricant on rubber of valves or diaphragm.*

d. Install the vacuum valve seat (fig. 15), being certain the gasket is in correct position. Tighten the four $\frac{3}{16}$ -inch screws evenly. Place the lower cover gaskets in position and install the lower cover, but do not force gaskets out of shape.

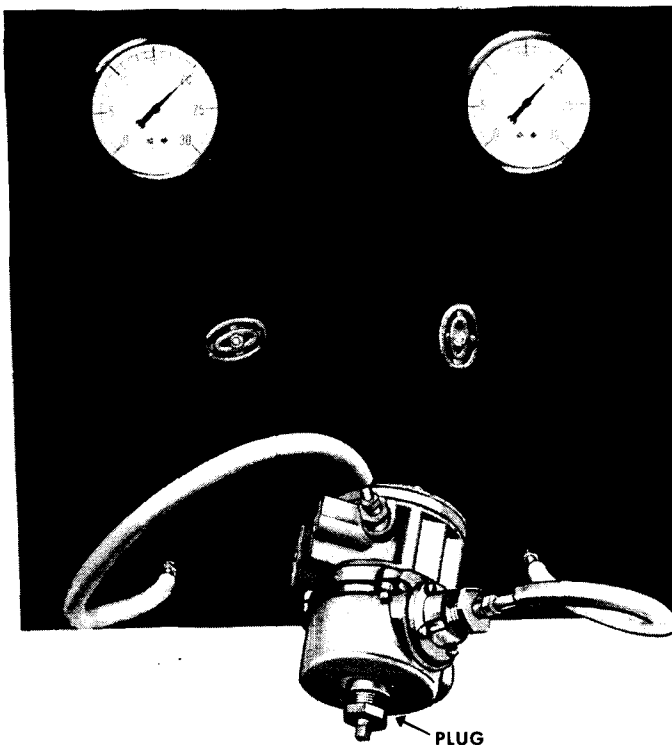
e. Place the release spring in position in center body section, and compress with fingers as illustrated in figure 92. Connect the upper diaphragm assembly to the lower assembly by sliding slot head of bolt over head of upper assembly (fig. 92). Register the housing by-pass channel with the by-pass channel in the lower body, using small ferrule inserted in hole of body section (fig. 91).

f. Place the spacer ring and top cover in position (fig. 91). Be sure the by-pass hole in the spacer ring lines up with the by-pass hole in the upper body section and that the ferrule is in position. Tighten the long body screws evenly.

**ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)**

50. BENCH TEST.

- a. Attach the left-hand connection on the test panel (BX-SER-452) to the control port of the valve; attach the right-hand connection on the test panel to the vacuum port (fig. 94).
- b. Plug the cylinder port with an airtight plug (fig. 94).



RA PD 312325

**Figure 94—Testing Conversion Valve, using Test Panel
(BX-SER-452)**

c. Open both test panel valves until both gages register from 16 to 20 inches of vacuum; then close the right-hand test panel valve. Maximum allowable drop in vacuum in right-hand gage is 3 inches in 15 seconds. With this hook-up there is vacuum in both upper diaphragm chambers and atmosphere in both lower chambers; therefore, the valve remains in released position. This test determines if there are any leaks in the upper diaphragm chamber or at the vacuum valve and seat (fig. 91).

d. Close the left-hand test panel valve, and remove the connection at valve. Again open the right-hand valve on the test panel until

CONVERSION VALVE

the gage shows 16 to 20 inches of vacuum; then close the valve. The vacuum drop should be not more than 3 inches in 15 seconds. Air is now in the chamber below the upper diaphragm (2, fig. 91). Atmospheric pressure in this chamber acting against the diaphragm, which is under vacuum on the opposite side, closes the atmospheric valve and opens the vacuum valve. This test determines whether there are leaks at the atmospheric valve, in the lower chamber, or through the upper diaphragm. The vacuum drop should be no more than 3 inches in 15 seconds.

e. Attach hose from left-hand side of test panel, and attach it to bottom cylinder port. Turn on vacuum from right-hand gage; left gage should be about 65 per cent of the vacuum at right gage on conversion valves "SPC"; all other valves should have a like vacuum on both gages.

ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)

CHAPTER 9

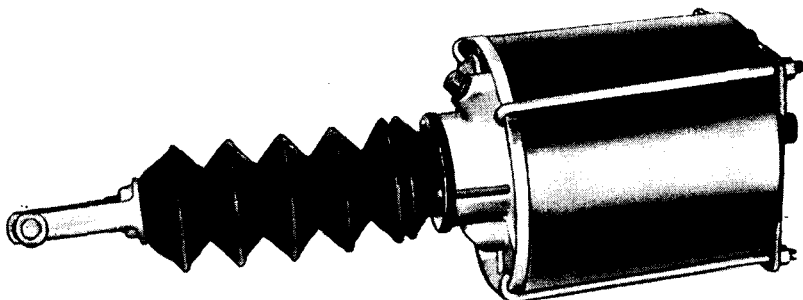
POPPET-TYPE VALVE REACTIONARY INTERNAL
VALVE POWER UNITS

Section I

DESCRIPTION, OPERATION, AND DATA

51. DESCRIPTION.

a. This unit has an internal control valve located in the hollow piston rod actuated by external pedal linkage. It is a vacuum-suspended unit, and is termed reactionary because the foot pedal linkage feeds an opposing force against foot pedal, resulting in what is commonly called "pedal feel," or reaction. **NOTE:** See *pertinent vehicle technical manual for operating linkage*.



RA PD 312326

**Figure 95—Poppet-type Valve Reactionary Internal Valve
Power Unit**

52. OPERATION.

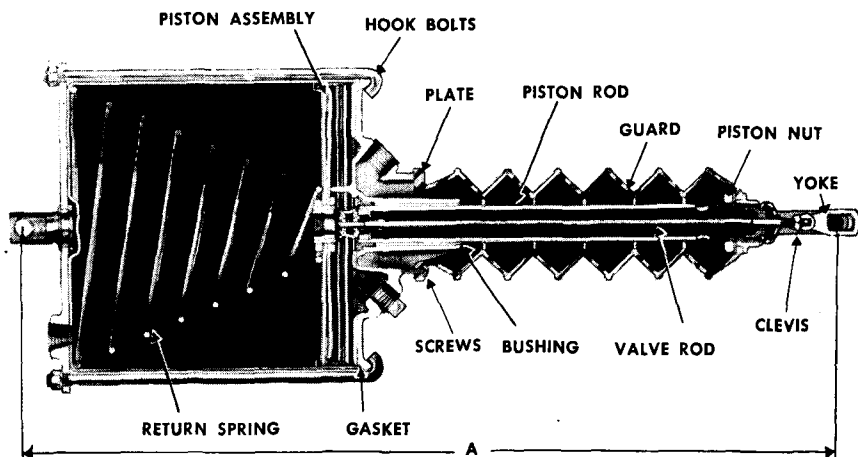
a. **Released** (fig. 97). As this unit is of the vacuum-suspended type, a vacuum is created on both sides of vacuum piston. The front shell is connected directly to the vacuum source, and a direct opening at the center of the piston allows vacuum to be present on other side of piston, thus suspending the piston in vacuum. A conical return spring holds piston in the off position, and a valve return spring holds valve in off position. Air is admitted into the hollow piston rod through port holes in piston rod and through rubber guard and air cleaner.

b. **Applied** (fig. 97). When foot pedal is depressed, the operating linkage moves valve rod toward the cylinder. This movement first seats vacuum valve, sealing off communication between both sides of vacuum piston. Secondly, the atmospheric valve leaves its seat, allow-

POPPET-TYPE VALVE REACTIONARY INTERNAL VALVE POWER UNITS

ing air from air cleaner and hollow piston rod into rear compartment of power cylinder, moving piston toward the vacuum side. Power cylinder piston rod is connected to brake linkage and applies brakes.

c. **Partial Application** (fig. 97). In the holding or partially applied position, the piston will position itself at the point reached when both vacuum and atmospheric valves are on their respective seats.



RA PD 312327

Figure 96—Sectional View of Poppet-type Valve, Reactionary Internal Valve Power Unit

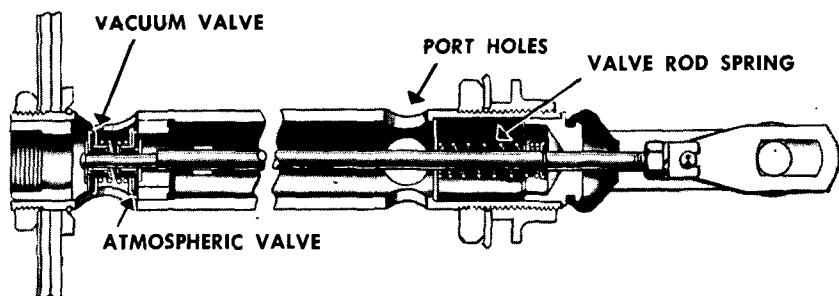
53. IDENTIFICATION DATA.

a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

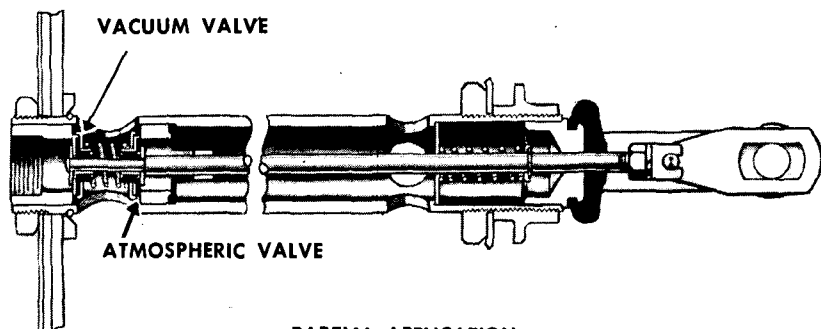
b. **Identification Data.** The following table is supplied to assist in identification of models and determining the repair kit to be used in repair of the unit.

Bendix Number	Ordnance Number	Model Number	REPAIR KITS	
			Bendix No.	Ordnance No.
371893	D48121	R76-6	373375	A303372
			373376	A303373
370001	D48121	R76-6	373375	A303372
			373376	A303373
370002	.....	R66-6	372117	.....
373201	.....	R66-6	372117	.....
BK17890	.....	R66-6	372117	.....

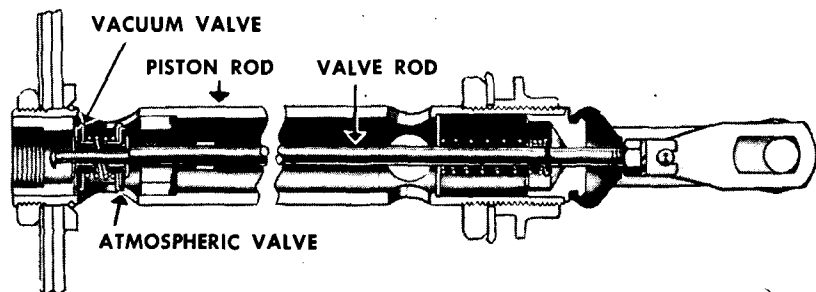
**ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)**



RELEASED



PARTIAL APPLICATION



APPLIED

RA PD 312328

Figure 97—Sectional View of Valve Rod—Applied, Released, and Partially Applied Positions

**POPPET-TYPE VALVE REACTIONARY INTERNAL
VALVE POWER UNITS**

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

54. DISASSEMBLY.

a. **Preliminary Instructions.** Clean externally. Scribe a mark across shell and end plate so unit will be assembled in its original position (fig. 95).

b. **Disassemble Unit.** Remove piston rod clevis, valve rod yoke, and nut (fig. 96). Remove piston rod rubber guard. Remove four hook bolts, piston, and return spring. **CAUTION:** *Be careful, as spring is under compression.* Remove piston assembly, end plate, and seal. Remove bushing if worn (fig. 96).

55. CLEANING, INSPECTION, AND REPAIR.

a. **Clean.** Clean all metal parts in carburetor cleaning solution and rinse in dry-cleaning solvent.

b. **Inspect.** Inspect for broken parts and condition of shell. If rusted or pitted, polish with fine grade steel wool. If piston rod is scored or pitted, replace with new rod.

c. **Repair.** Using the proper repair kit for the model unit being repaired (par. 53), remove the contents of the carton and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective.

Section III

ASSEMBLY AND TEST

56. ASSEMBLY.

a. **End Plate Bushing and Seal.** Install new bushing (fig. 96) if old one is worn. Soak leather seal in light shock absorber fluid, and install it with lip toward bushing; put flat washer over seal, and install snap ring (fig. 16). Be sure washer and seal are centered. **NOTE:** *Use piston rod as guide when installing seal and washer.* Install snap ring in groove on piston rod and place flat stop washer with wide end of tapered hole over snap ring (fig. 98).

b. **R-76 Units** (fig. 99). Position felt retainer plate "A" with concave side down. Place felt "B" in space provided on retainer plate. Place larger diameter plate "C" over felt retainer, and leather

ORDNANCE MAINTENANCE VACUUM BRAKE SYSTEMS (BENDIX B-K)

packing "D," lip up, over plate. Brush a ring of shellac at center hole of plate. Install smaller plate "E" with sharp edge against leather. Install piston packing expansion ring "F" against lip of leather with prongs pointing against leather and toward lip of packing. Place piston on piston rod with leather packing lip toward rod (fig. 96). Brush shellac on threads and install piston rod nut tightly.

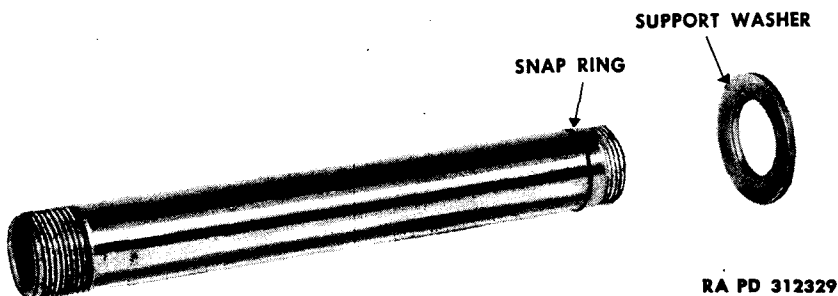
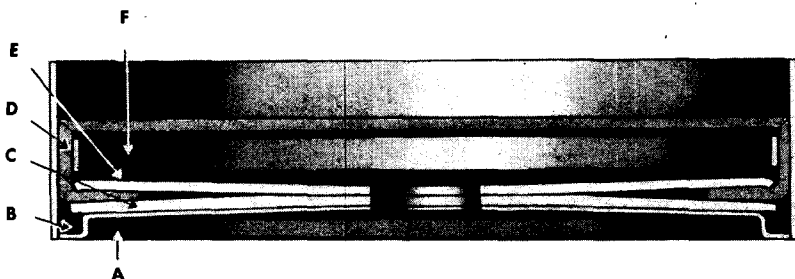


Figure 98—Snap Ring and Support Washer



RA PD 312330

Figure 99—Piston Assembly in Ring

c. R-66 Units (fig. 99). Position larger plate "C" with concave side down. Install piston packing "D" with leather lip up. Install smaller plate "E" with concave side against piston packing, felt "B," expansion spring "F" with prongs upward and against leather, and felt retainer plate "A." Place piston on piston rod with lip of leather packing toward piston rod. Brush shellac on threads, and install piston rod nut tightly.

d. Final Assembly.

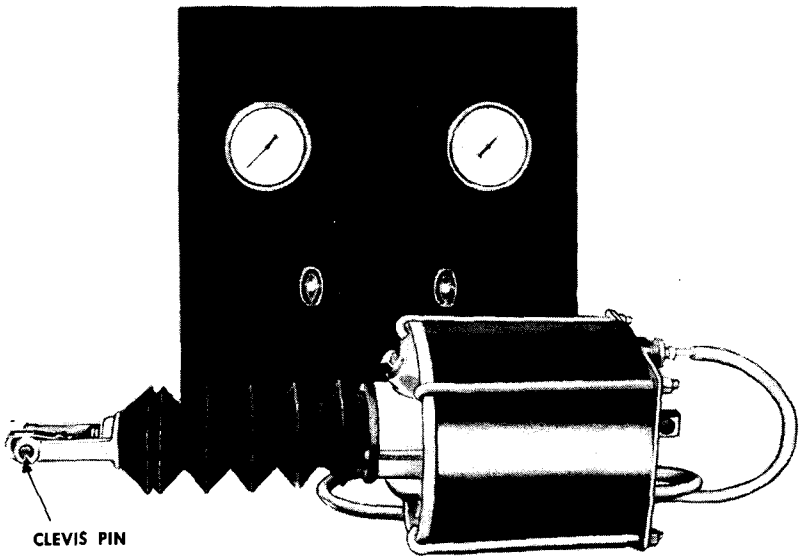
(1) Hold shell with open-side up. Place conical return spring in shell, larger diameter first (fig. 96). Put gaskets on end plate. Place piston and rod assembly over smaller end of spring, and force piston into shell. Put end plate in position (scribe marks matched), and install hook bolts securely.

POPPET-TYPE VALVE REACTIONARY INTERNAL VALVE POWER UNITS

(2) Attach rubber piston guard to end plate with plate and screws (fig. 96). Install large piston rod nut, beveled edge away from cylinder. Install washer with dished side toward nut. Install clevis.

e. Preliminary Adjustment.

(1) Position clevis. Screw in or out until the measurement "A" of figure 96 between center of front yoke hole and center of piston rod yoke hole is $24\frac{1}{4}$ inches plus or minus $\frac{3}{32}$ inch. When measurement is ascertained, tighten nut against clevis. Stretch rubber guard over washer and place in groove of clevis.



RA PD 312331

Figure 100—Testing Poppet-type Valve Power Unit

(2) Install small nut on end of valve rod. Turn nut down to end of threads (fig. 95). Position trunnion clip with flat side toward nut. Place valve rod links on trunnion pins, and install assembly onto valve rod; lock trunnion clip in position to hold plates on trunnion.

f. Final Adjustment, R-66 and R-76. With fingers, force valve rod into cylinder until vacuum valve strikes the seat (fig. 97). (This can be definitely felt as valve contacts seat.) Hold rod in this position, place adjusting collar in plates, and swing assembly into yoke. In this position a clevis pin should fit perfectly through yoke and bushing. Adjust valve rod yoke on or off to obtain this setting. Remove adjusting tool.

**ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)**

57. BENCH TEST.

a. **Released.** Connect vacuum line of test panel (BK-SER-452) to nipple of cylinder shell. Turn vacuum on and when high vacuum is reached, turn vacuum off. There should not be more than a 2-inch drop of vacuum in 15 seconds.

b. **Applied.** Put clevis pin through clevis and valve rod yoke. Turn on vacuum. Push in valve rod to actuate unit until piston is drawn into shell, and turn off vacuum. There should not be more than a 2-inch drop in 15 seconds.

c. With vacuum on, actuate valve rod applying and releasing power unit, and test for holding position by stopping movement of valve rod at any given point.

CHAPTER 10

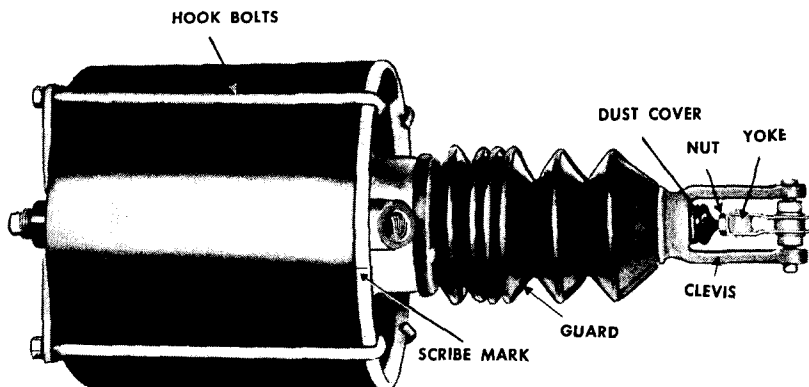
SLIDE-TYPE VALVE REACTIONARY INTERNAL VALVE POWER UNITS

Section I

DESCRIPTION, OPERATION, AND DATA

58. DESCRIPTION.

a. This unit has an internal control valve, located in the hollow piston rod that is actuated by an external pedal linkage. It is a vacuum-suspended unit and is termed reactionary because the foot pedal linkage feeds an opposing force against foot pedal, resulting in what is commonly called "pedal feel" or reaction. *NOTE: See pertinent vehicle technical manual for operating linkage.*



RA PD 312332

**Figure 101—Slide-type Valve Reactionary Internal Valve
Power Unit**

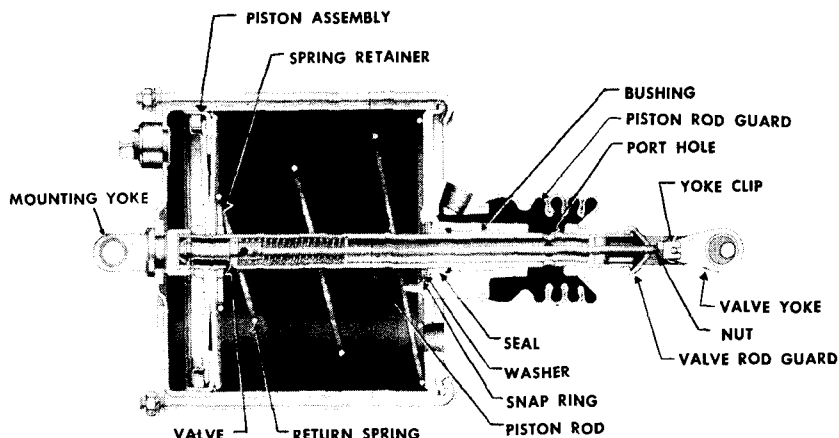
59. OPERATION.

a. **Released** (fig. 102). As this unit is of the vacuum-suspended type, a vacuum is created on both sides of the vacuum piston. The rear shell is connected directly to the vacuum source, and a direct opening in the center of the piston rod allows vacuum to be present on other side of piston, thus suspending the piston in vacuum. A conical spring holds piston in the off position, and a valve return spring holds valve in off position. Air is always present inside of the hollow piston rod, as port holes at clevis end of piston rod are in direct communication with air cleaner.

b. **Applied** (fig. 103). When the foot pedal is depressed, the operating linkage moves valve rod outward from the cylinder. This movement first causes valve piston to cover atmospheric port slots in piston rod, sealing off communication between both sides of vacuum piston. Secondly, the valve piston passes beyond atmospheric port

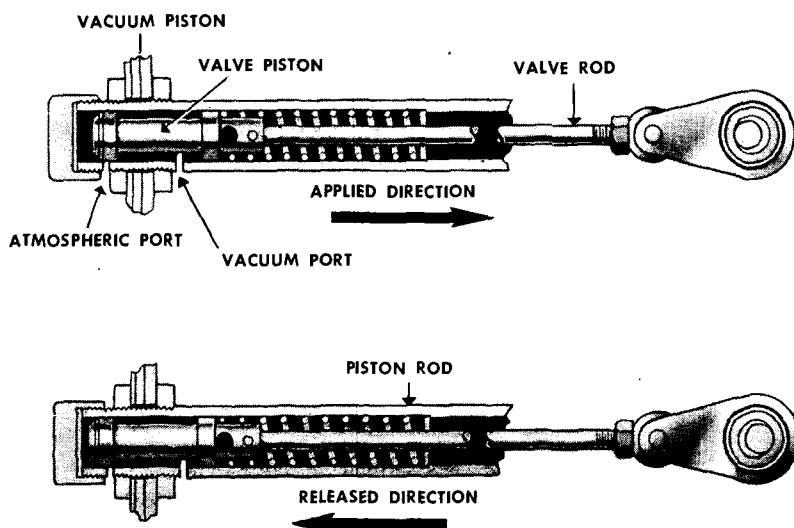
ORDNANCE MAINTENANCE VACUUM BRAKE SYSTEMS (BENDIX B-K)

slots in piston rod, allowing air from air cleaner to pass through hollow piston rod and hollow valve piston into the front compartment of power cylinder, thereby causing vacuum piston to move toward the vacuum side of cylinder. The power cylinder piston rod, connected to brake linkage, applies the brakes.



RA PD 312333

Figure 102—Sectional View of Slide-type Valve Reactionary Internal Valve Power Unit



RA PD 312334

Figure 103—Sectional View of Valve Rod

SLIDE-TYPE VALVE REACTIONARY INTERNAL VALVE POWER UNITS

c. **Partial Application** (fig. 103). In the holding or partially applied position, the vacuum piston will position itself at the point reached when the valve piston is just at the point of uncovering the atmospheric port slots in either direction of valve rod movement.

60. IDENTIFICATION DATA.

a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

b. **Identification Data.** The following table is supplied to assist in identification of models and determining the repair kit to be used in repair of the unit.

Bendix Number	Ordnance Number	Model Number	REPAIR KITS	
			Bendix No.	Ordnance No.
BK 21670	D 72414	RP60	370680	.....
BK 21750	D 72384	RP60	{ 373403	A-303487 }
			{ 373404	A-303488 }
BK 16725	D 33796	RP66	{ 373378	A-303375 }
			{ 373379	A-303376 }

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

61. DISASSEMBLY.

a. **Preliminary Instructions.** Clean unit externally. Scribe a mark across shell and end plate so unit will be assembled in an identical manner (fig. 101).

b. **Disassemble Unit.** Remove piston rod clevis and valve rod yoke and nut (fig. 102). Remove piston rod rubber guard and valve rod guard. Remove four hook bolts carefully as end plate may be ejected by return spring. Remove end plate, vacuum piston return spring, and vacuum piston and rod assembly.

62. CLEANING, INSPECTION, AND REPAIR.

a. **Clean.** Clean all metal parts with carburetor cleaning solution, and rinse in dry-cleaning solvent.

b. **Inspect.** Inspect for broken parts and condition of shell. If shell is rusted or pitted, polish with fine grade steel wool.

ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)

c. **Repair.** Using the proper repair kit for the model unit being repaired (par. 60), remove the contents of the carton, and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective.

Section III

ASSEMBLY AND TEST

63. ASSEMBLY.

a. **Install End Plate Bushing and Seal** (fig. 102). Install new bushing if old one is worn. Soak leather seal in light shock absorber fluid and install it in end plate with its lip toward the bushing. Place flat washer over seal and install snap ring (fig. 16).

b. **Install Piston Assembly.** Place piston completely in shell. Place small end of piston return spring over rod and against piston, being sure that spring retainer plate is encircled. Install gasket on end plate, put end plate on rod, and install hook bolts. Line up scribe marks before tightening securely.

c. **Install Clevis.** Place rubber piston guard over piston rod with wide end first. Screw on jam nut and piston rod clevis. Position clevis so that the center of clevis pin hole is $12\frac{23}{32}$ inches from the center of hole in the mounting yoke (fig. 102). Lock jam nut against clevis.

d. **Install Valve Rod Yoke** (fig. 102). Install rubber valve rod guard, and install valve rod lock nut and valve rod yoke clip with flat side to nut. Install valve rod yoke end assembly to valve rod, and lock yoke clip on pins with flat side of yoke to clip. Connect piston rod guard at both ends.

e. **Preliminary Adjustment.** Place adjusting bushing tool BK T-25102 in yoke. Valve rod should be all the way in piston rod. Position yoke so that when clevis pin is inserted through clevis it will be touching the bushing on the side farthest from the cylinder. Temporarily set jam nut at this point.

f. **Final Adjustment.** Connect the end plate port to a vacuum line and turn on vacuum. Remove adjusting bushing and put in a new clevis pin. Using the fingers, actuate the valve rod through travel allowed by clevis pin. Moving valve rod outward against clevis pin should actuate vacuum piston to applied position. Moving valve

**SLIDE-TYPE VALVE
REACTIONARY INTERNAL VALVE POWER UNITS**

rod toward cylinder releases vacuum piston and piston return spring returns the piston. Balance the speed of operation in both directions by moving yoke on piston rod, and repeat operation of valve rod until both rapid application and release are obtained. Lock jam nut on valve rod securely. Leave port connected to vacuum.

64. BENCH TEST.

a. Released. Have piston in released position. Turn vacuum on, and then off. Vacuum drop should not exceed 5 inches in 3 seconds.

b. Applied. Turn on vacuum. Apply unit by actuating valve rod with fingers. Hold in applied position, and turn off vacuum. Drop in vacuum should not be more than 5 inches in 3 seconds. **NOTE:** *Replace manufacturer's and using arms identification tags. Close all openings with corks, masking tape, or other methods.*

ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)

CHAPTER 11

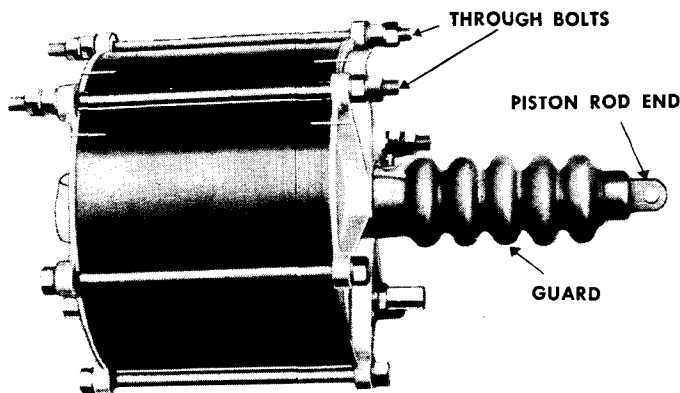
PDL-6 AND PDLP-6 POWER CYLINDERS

Section I

DESCRIPTION, OPERATION, AND DATA

65. DESCRIPTION.

a. The PDL-type cylinder is a power unit controlled by an external operating valve. It is composed of a shell and two end plates each having a hose nipple, a piston, and piston rod. It is a puller unit of the vacuum-suspended type, and its piston rod is connected to brake operating linkage. The PDLP type has the same construction, except that piston is reversed on piston rod, converting it to a pusher unit. Also, return spring is on opposite side of piston.



RA PD 312335

Figure 104—PDL-type Power Cylinder

66. OPERATION.

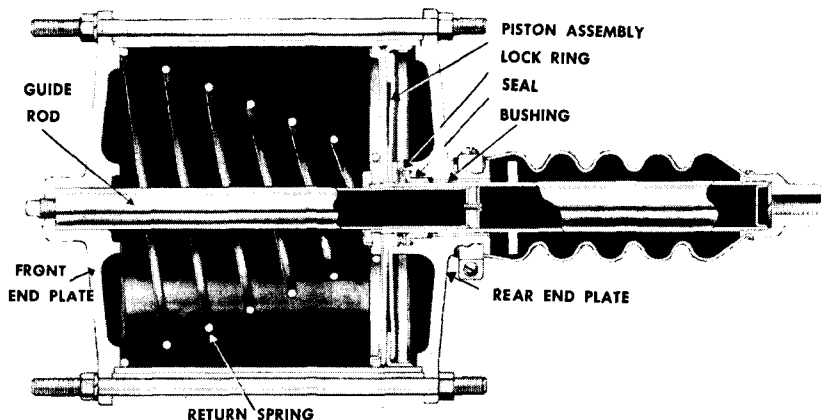
a. Vacuum from the intake manifold is present on one side of piston because of a direct connection to the manifold. Presence of vacuum on the other side of the piston is controlled by an external control valve. Piston is held in released position by an internal return spring, or return spring in brake system. It is operated by a depletion or drop of vacuum on one side of piston while vacuum on other side is held. The piston moves toward the higher vacuum side when atmosphere enters opposite side.

b. Released, applied, and holding positions are governed by the position of control valve. These positions also are duplicated on vacuum trailer brakes if installed on a towing vehicle.

PDL-6 AND PDLP-6 POWER CYLINDERS

67. IDENTIFICATION DATA.

a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.



RA PD 312336

Figure 105—Sectional View of PDL-type Power Cylinder

b. **Identification Data.** The following table is supplied to assist in identification of models and determining the repair kit to be used in repair of the unit.

Bendix Number	Ordnance Number	Model Number	Repair Kit Bendix No.
BK14194	.....	PDL6	370670
371470	.....	PDL6	370670
BK19178	B264174	PDLP6	370670

PDL-6—Puller Cylinder—6 inches of stroke

PDLP-6—Pusher Cylinder—6 inches of stroke

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

68. DISASSEMBLY.

a. **Preliminary Instructions.** Clean unit externally. Scribe a line across cylinder and end plates, and mark end plates where through bolts are positioned (fig. 104).

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VACUUM BRAKE SYSTEMS (BENDIX B-K)

b. **Disassemble Unit.** Remove piston rod end (fig. 104) from piston rod, and remove piston rod rubber guard. Remove through bolts and studs holding end plates to shell, and separate assembly.

c. **Remove Piston Assembly.** Remove piston return spring (fig. 105). Remove rear end plate from piston rod. Remove nut attaching piston assembly to piston rod, and remove piston assembly.

d. **Remove End Plate Seal and Bushing** (fig. 105). Remove lock ring, washer, and leather seal from rear end plate.

69. CLEANING, INSPECTION, AND REPAIR.

a. **Clean.** Clean all metal parts in carburetor cleaning solution, and rinse with dry-cleaning solvent.

b. **Inspect.** Inspect shell for corrosion, rust, or pitting; polish with fine steel wool if necessary. Inspect end plates for cracks. Replace piston rod if pitted or distorted.

c. **Repair.** Using the proper repair kit for the model unit being repaired (par. 67), remove the contents of the carton and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective.

Section III

ASSEMBLY AND TEST

70. ASSEMBLY.

a. **Assemble Piston Ring.** Position felt retainer plate "A" with flat surface up, and install felt "B." Install larger diameter plate "C" over felt retainer. Install leather packing "D," lip upward. Brush a ring of shellac around the center hole of plate. Install smaller diameter plate "E" with sharp edge against leather packing. Insert piston expansion ring "F" against lip of leather with the prongs pointing upward and into leather.

b. **Assemble Piston Rod.** Place piston rod, with open end up, in a vise with brass jaws. Install flat washer with groove toward snap ring on piston rod (fig. 98). Pick up piston assembly and place it over lip of leather packing facing downward for PDL cylinder, and upward for PDL cylinder. Brush a small amount of shellac around the threads of piston rod, and install nut tightly. Remove assembly from vise.

c. **Assemble End Plate and Bushing.** Replace bushing in rear end plate (fig. 105). Dip leather seal in oil and install it, lip first,

PDL-6 AND PDL-6 POWER CYLINDERS

into center plate. Insert flat washer and snap lock ring (fig. 16).
NOTE: *Snap ring and leather must be centered.*

d. Final Assembly for PDL-type Only.

(1) Place end plate over piston rod with leather seal end first. Place a gasket around both end plates.

(2) Insert the piston about 1 inch inside of cylinder and make sure that the piston expansion ring is in place. Relocate ring if necessary. Bring end plate up against shell and match scribe mark.

(3) Install return spring (fig. 105) with small end against piston. Install front end plate, inserting guide rod into hollow piston rod. Compress spring with end plate, and line up scribe marks. Install through bolts and tighten evenly, crossing over from one to another. (Do not draw up these bolts too tightly.) Install rubber piston rod guard and piston rod end (fig. 104).

e. Final Assembly for PDL-6 Type.

(1) Put new gasket on front end plate (one which has guide rod attached, fig. 105), and place plate in and against shell. Install piston, pushing piston over guide rod and into shell.

(2) Install gasket on rear end plate. Install return spring, small diameter against piston; compressing spring with rear end plate, set the plate against shell. Match scribe marks and install through bolts. Tighten nuts evenly, crossing over from one to another. (Do not draw too tightly.) Install rubber piston rod guard lock washer and piston rod (fig. 104). Set piston rod end by tapping wrench with rawhide hammer.

71. BENCH TEST.

a. PDL Type.

(1) **RELEASED.** Install a vacuum line to both cylinder ports. Turn vacuum on and then off. Vacuum drop should not exceed 3 inches in 15 seconds.

(2) **APPLIED.** Remove hose from rear end of cylinder, and turn on vacuum in front end only. Piston will now pull in to end of stroke. Turn off vacuum. Vacuum drop should not exceed 1 inch in 15 seconds.

b. PDL-6 Type.

(1) **RELEASED.** Install a vacuum line to both cylinder ports. Turn vacuum on and then off. Vacuum drop should not exceed 3 inches in 15 seconds.

(2) **APPLIED.** Remove hose from front end of cylinder, and turn on vacuum in rear end only. Piston will now push out to end of stroke. Turn off vacuum. Vacuum drop should not exceed 1 inch in 15 seconds.

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VACUUM BRAKE SYSTEMS (BENDIX B-K)**

CHAPTER 12

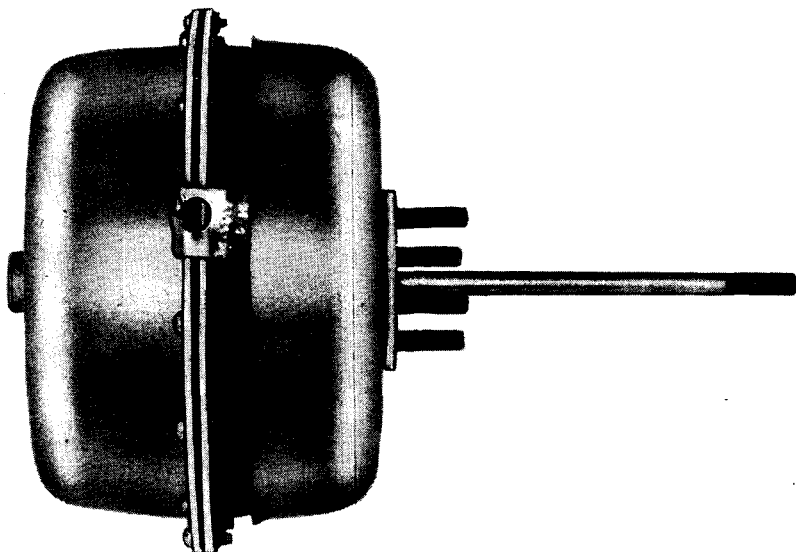
D-64 POWER CHAMBER

Section I

DESCRIPTION, OPERATION, AND DATA

72. DESCRIPTION.

a. This type power chamber (Bendix No. B-K-19945) is very simple in construction, and consists of two shells separated by a rubber diaphragm with a pull rod attached. The pull rod end of the chamber is open to atmosphere at all times, and the opposite end is connected to a vacuum during an application of brakes. When a vacuum is created in the chamber, atmosphere on the opposite side forces the diaphragm and pull rod toward the vacuum side and, as the pull rod is connected to a brake lever, the brakes are applied.



RA PD 312337

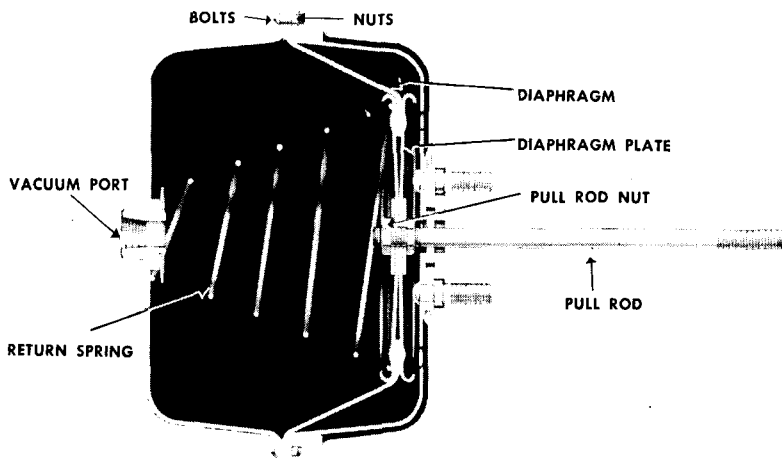
Figure 106—D-64 Power Chamber

73. OPERATION.

a. **Released.** When the brakes are in the released position, atmospheric pressure is present on both sides of the rubber diaphragm.

b. **Applied.** When brakes are applied, the vacuum side of the power chamber is emptied of air, creating a vacuum. The diaphragm pulls rod, thereby applying brakes.

D-64 POWER CHAMBER



RA PD 312338

Figure 107—Sectional View of D-64 Power Chamber

c. **Partial Application.** The vacuum may be built up in the vacuum side to any degree, as it is controlled by a graduating-type valve somewhere in the system (on towing vehicle).

74. IDENTIFICATION DATA.

a. **Identification Tags.** Identification data as to model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

75. DISASSEMBLY.

a. **Preliminary Instructions.** Clean power chamber externally.

b. **Disassemble Unit.** Remove the bolts and nuts holding the chambers together, and separate chambers from diaphragm. **NOTE:** *Care must be exercised as there is a large coil return spring inside the chamber.* Remove pull rod nut at diaphragm end, and remove upper diaphragm plate on diaphragm (fig. 107). Remove diaphragm and lower diaphragm plate.

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VACUUM BRAKE SYSTEMS (BENDIX B-K)

76. CLEANING, INSPECTION, AND REPAIR.

- a. Clean.** Clean metal parts in carburetor cleaning solution, and rinse in dry-cleaning solvent.
- b. Inspect and Repair.** Inspect for broken or distorted parts and replace if necessary.

Section III

ASSEMBLY AND TEST

77. ASSEMBLY.

- a. Assemble Unit (fig. 107).**

(1) Install new rubber diaphragm with plate on each side on pull rod; welt in diaphragm must fit in groove of plate. Tighten nuts on pull rod securely.

(2) Place conical spring, small end first, into front shell. Place diaphragm assembly over spring, and be sure spring rests against diaphragm plate.

(3) Compress spring and install other shell; line up holes in diaphragm and shells, and install nuts securely.

78. BENCH TEST.

- a. Attach a vacuum line to hose nipple at vacuum port and turn on vacuum. Turn off vacuum. There should be no vacuum drop in 15 seconds.**

CHAPTER 13

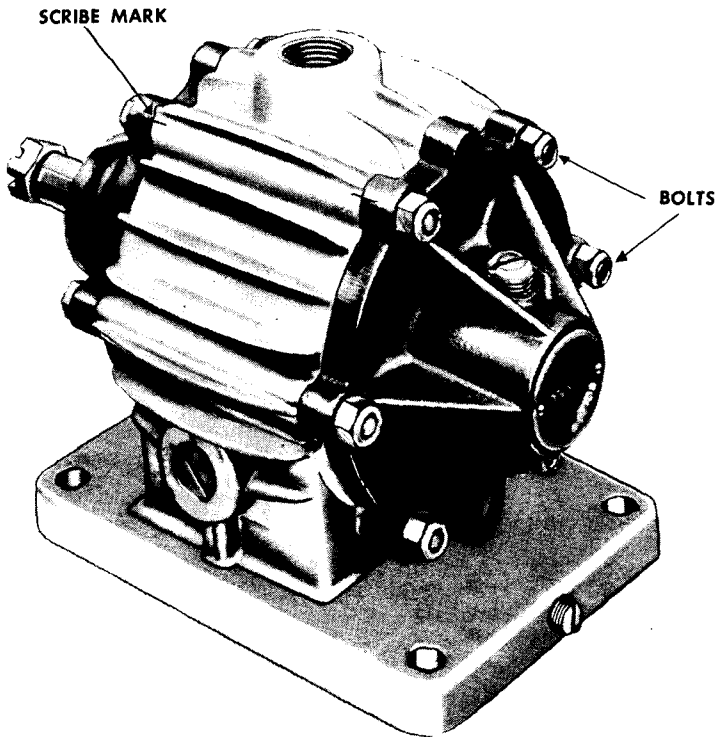
CONVAC PUMP

Section I

DESCRIPTION, OPERATION, AND DATA

79. DESCRIPTION.

a. The convac pump is a rotary-type vacuum pump driven by the engine (fig. 108). It is used to create a vacuum for brake operation. The body of a convac pump provides a closed cylindrical shell with its axis offset or eccentric with the axis of the rotor (fig. 109).



RA PD 312339

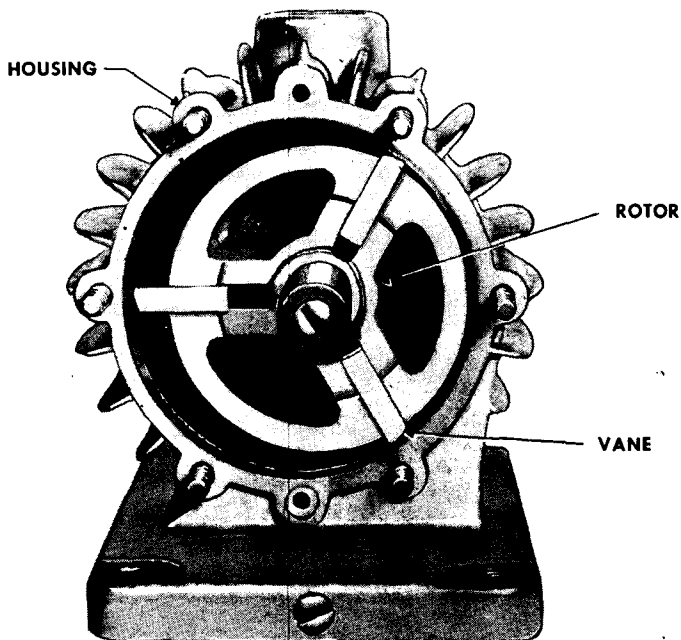
Figure 108—Convac Pump

The rotor is provided with three floating vanes which are held in contact with the cylinder walls by centrifugal force. These vanes divide the space between the rotor and cylindrical walls into three airtight compartments.

**ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)**

80. OPERATION.

a. As the rotor turns, the volume of each of the three compartments increases and decreases, due to the eccentric position of the rotor (fig. 109). Air is drawn into the three compartments during the portion of the turn when their volume is increasing. An outlet port is provided through which air is expelled as the compartments decrease in volume. The result is a high vacuum for power brake application. This pump is engine-lubricated by an oil pump furnishing oil from the crankcase. It is extremely important that the engine crankcase oil be kept free from dirt and foreign matter.



KA PD 312340

Figure 109—Sectional End View of Convac Pump

81. IDENTIFICATION DATA.

a. **Identification Tags.** Identification data as to model number is stamped on end plate and should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

CONVAC PUMP

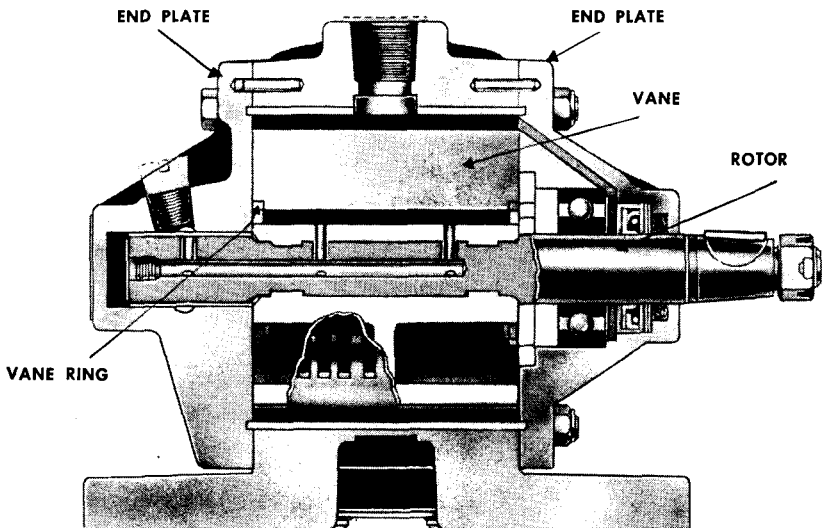
Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

82. DISASSEMBLY.

a. **Preliminary Instructions.** Clean pump externally. Scribe a mark across end plates to housing. These lines should match to ensure assembling in original position.

b. **Disassemble Unit.** Remove the six bolts which hold end plates to body housing (fig. 100). Remove end plates, rotor, rotor vanes, and vane rings.



RA PD 312341

Figure 110—Sectional Side View of Convac Pump

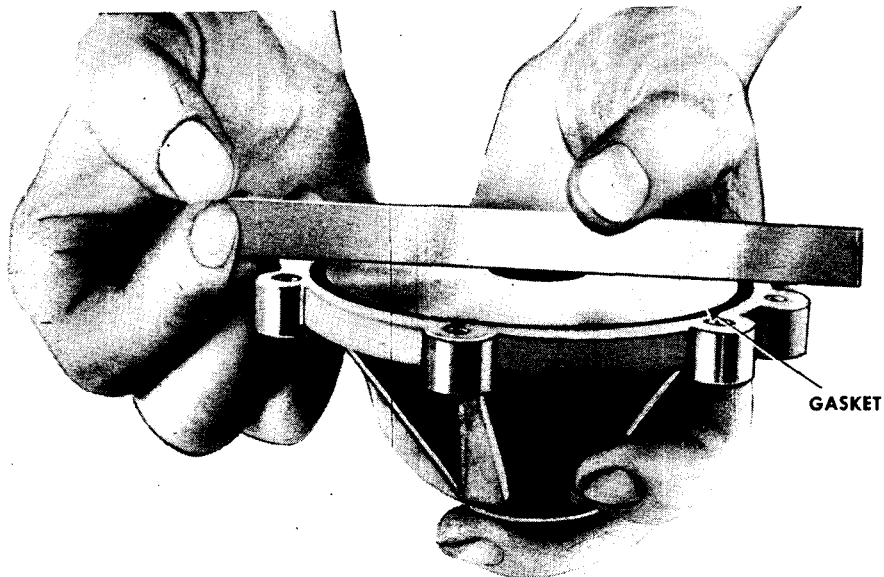
83. CLEANING.

a. Clean all metal parts in carburetor cleaning solution and rinse in dry-cleaning solvent. Blow out all passages with compressed air.

84. INSPECTION AND REPAIR.

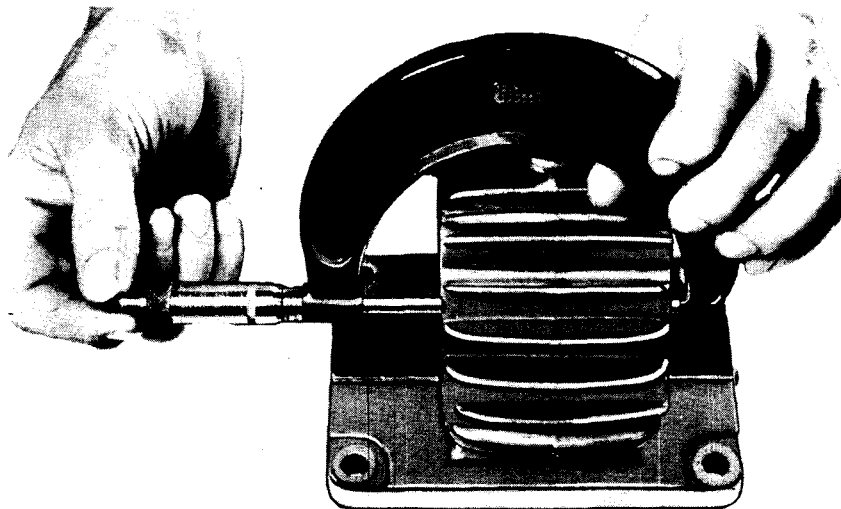
a. Place a steel scale or straightedge across the end plate, and hold to the light to check for evidence of uneven wear; concavity should not be more than 0.003 inch (fig. 111). Check this measurement with a feeler gage; if end plate is worn or scored, replace with a new part. Check the end plate bushing by installing the closed-end end plate over the rotor shaft. If there is perceptible play, a complete new end plate should be used. The leather seal and ball bearing in the open-end end plate should be replaced with new parts, if worn.

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VACUUM BRAKE SYSTEMS (BENDIX B-K)**



RA PD 312342

Figure 111—Inspecting End Plate



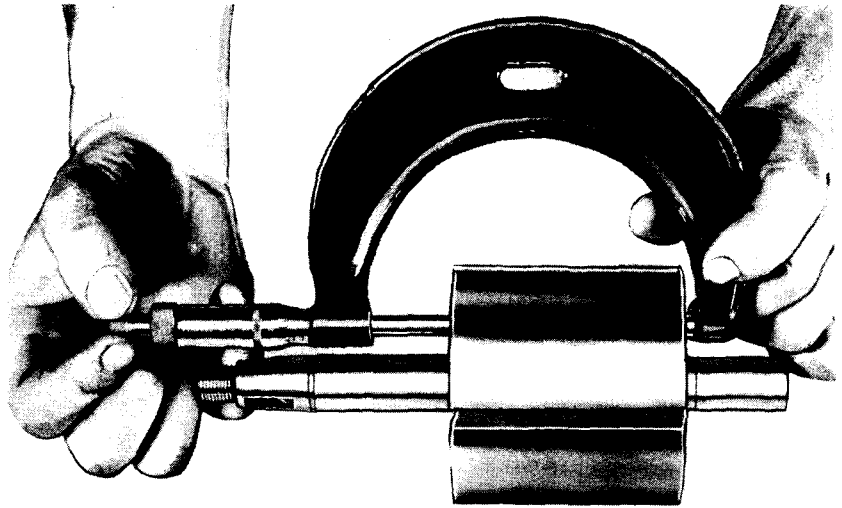
RA PD 312343

Figure 112—Inspecting Housing, using Micrometers (41-C-307)

CONVAC PUMP

Inspect the surfaces of the rotor and the cast iron sleeve in pump housing; replace if scored. The three vane slots should be smooth and unscored. If there is any doubt, replace with new rotor. With a new vane in slot, the clearance between the vane and the slot should not be more than 0.020 inch. Use a feeler gage to measure clearance.

b. Examine the edge of rotor slots. If they have a saw-tooth appearance, replace the rotor. When a new rotor and new vanes are used, the minimum clearance should be 0.005 inch minimum, and 0.020 inch maximum.



RA PD 312344

Figure 113—Inspecting Rotor, using Micrometers (41-C-307)

c. The length of the housing from the machined flange faces should be between 3.187 and 3.189 inches (fig. 112). *NOTE: Be sure to set the micrometer on the machine flange instead of the cast iron lining. Take this micrometer reading at six equally spaced positions on the housing.*

d. The length of the rotor should be measured with a micrometer and should be between 3.181 and 3.182 inches (fig. 113).

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VACUUM BRAKE SYSTEMS (BENDIX B-K)

Section III

ASSEMBLY AND TEST

85. ASSEMBLY PROCEDURE.

a. Extreme care must be exercised when assembling this pump to be sure that all parts are clean, and that no grit or foreign matter adheres to any surface. Wipe each part dry, and clean with a clean cloth just before assembling.

b. Install new gaskets in end plates (fig. 111). Place rotor with vane ring over shaft in closed-end end plate (fig. 109). Insert the three vanes, making sure that the notches position themselves over the vane ring. Install other vane ring and end plate.

c. Install the six bolts and draw up the nuts as tightly as possible with the fingers, and then tighten each nut evenly, a little at a time, progressing across the plate from the nut last tightened (fig. 108).

d. Be certain there is no binding in the pump, and that there is between 0.004- and 0.006-inch end play in the pump after it has been assembled (without oil). A dial indicator should be used to measure this end play. Repeat measurement at each one-quarter turn of rotor.

e. Inject a couple of ounces of light engine oil into the pump before it is installed on the vehicle or stored.

86. TEST.

a. There is no bench test to be made on this unit. Test unit on engine when completely installed, or simulate engine installation and run pump at about 3,000 revolutions per minute. Vacuum attained should be between 20 and 28 inches of mercury.

CHAPTER 14

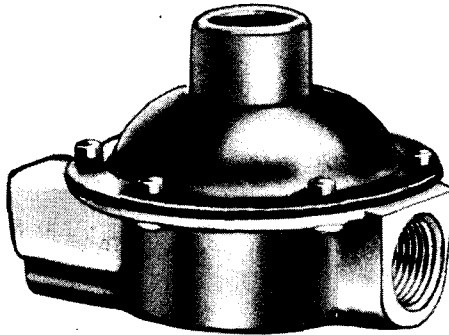
PV CHECK VALVE

Section I

DESCRIPTION, OPERATION, AND DATA

87. DESCRIPTION.

a. The PV (power vacuum) check valve (Bendix No. 370120) is installed on trucks in a vertical position in the line to the intake manifold. The purpose of the check valve is to trap vacuum in the system at its highest point.



RA PD 312345

Figure 114—PV Check Valve

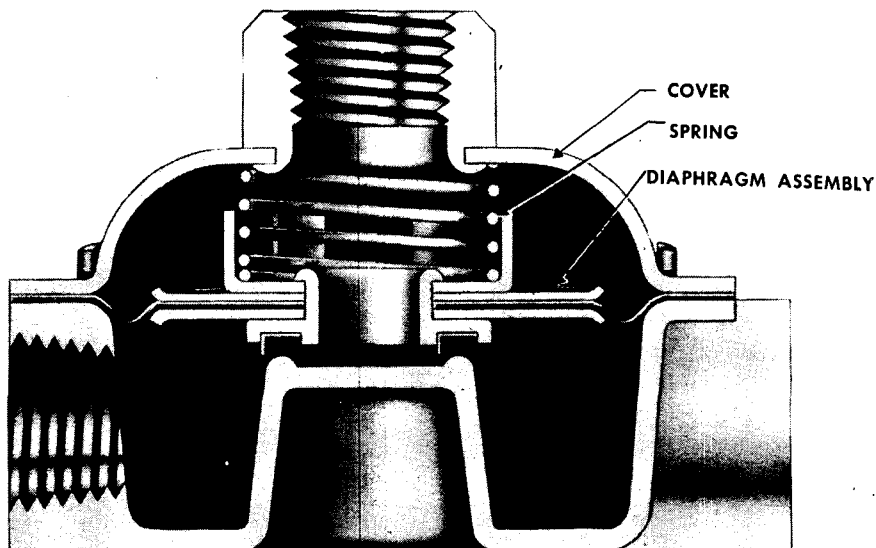
88. OPERATION.

a. When the vacuum on top of check valve is less than that at the bottom, the unbalanced condition causes the diaphragm to seat the valve, holding the higher vacuum in the system in readiness for brake application (fig. 115).

89. IDENTIFICATION DATA.

a. **Identification Tags.** Identification data as to model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

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VACUUM BRAKE SYSTEMS (BENDIX B-K)**



RA PD 312346

Figure 115—Sectional View of PV Check Valve

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

90. DISASSEMBLY.

a. Remove six machine screws and lock washers, and remove cover from body. Lift out diaphragm assembly, spring, and gasket.

91. CLEANING, INSPECTION, AND REPAIR.

a. **Clean.** Remove all dirt.

b. **Inspect.** If seat is corroded or pitted, polish with fine grade steel wool.

c. **Repair.** Using the proper repair kit for the model unit being repaired (par. 89), remove the contents of the carton and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective.

PV CHECK VALVE

Section III

ASSEMBLY AND TEST

92. ASSEMBLY.

a. Install diaphragm assembly and gasket. Place spring and cover in place, and install the six machine screws (fig. 115).

93. BENCH TEST.

a. Connect vacuum line to side port, turn vacuum on, and then off. There should be vacuum drop in 15 seconds.

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VACUUM BRAKE SYSTEMS (BENDIX B-K)

CHAPTER 15

PT CHECK VALVE

Section I

DESCRIPTION, OPERATION, AND DATA

94. DESCRIPTION.

- a. The PT (power valve) check valve is installed in the right-hand line of trailer vacuum brake system.
- b. The purpose of this check valve is to provide for automatic trailer brake application in the event of accidental breakaway.

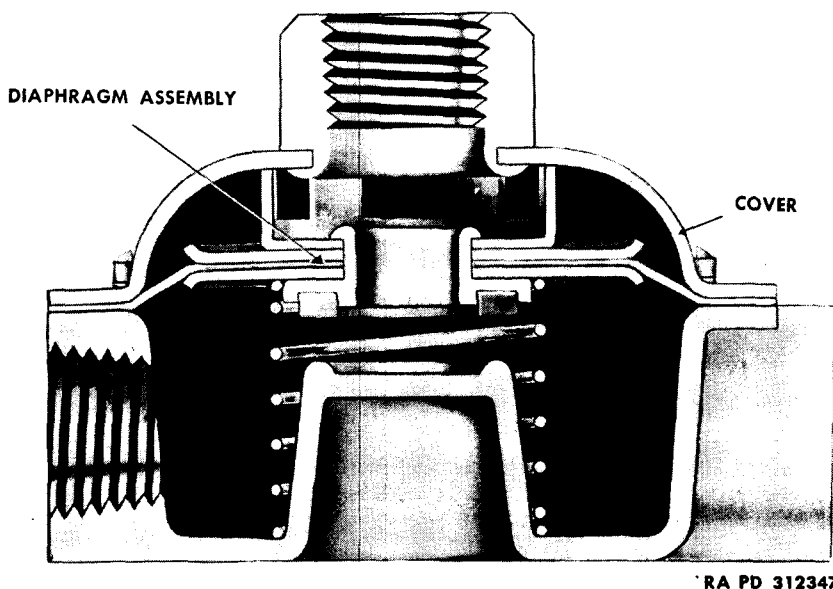


Figure 116—Sectional View of PT Check Valve

95. OPERATION.

- a. When the right hose breaks, the rush of air into the hose strikes the diaphragm moving it and valve against the seat, holding vacuum in the reservoir. The control line, when broken, allows air to enter, operating the relay or conversion valve and creating an emergency brake application.

96. IDENTIFICATION DATA.

- a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached

PT CHECK VALVE

to the unit by the using organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

b. Identification Data. The following table is supplied to assist in identification of models, and determining the repair kit to be used in repair of the unit.

Bendix Number	Ordinance Number	Model Number	Repair Kit Bendix No.
370121	B264262	PT	370660

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

97. DISASSEMBLY.

a. Remove the six machine screws which hold the cover to main body. Remove diaphragm, seat assembly, and the spring (fig. 116).

98. CLEANING, INSPECTION, AND REPAIR.

a. Clean. Remove dirt.

b. Inspect. If seat is corroded or pitted, polish with fine grade steel wool.

c. Repair. Using the proper repair kit for the model unit being repaired (par. 96), remove the contents of the carton and exchange the new parts one by one with the old parts from their respective groups. Place all the old parts in the empty carton for disposal, and to keep them from being confused with the new. In addition to the parts in the kit, replace any of the parts inspected which are defective.

Section III

ASSEMBLY AND TEST

99. ASSEMBLY.

a. Install new gasket, spring, and diaphragm assembly; install the six screws evenly and securely (fig. 116).

100. BENCH TEST.

a. Connect vacuum line to side port. Hold hand over top port and turn vacuum on. Sudden release of hand should seat valve and there should be no vacuum drop in 15 seconds.

ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)

CHAPTER 16

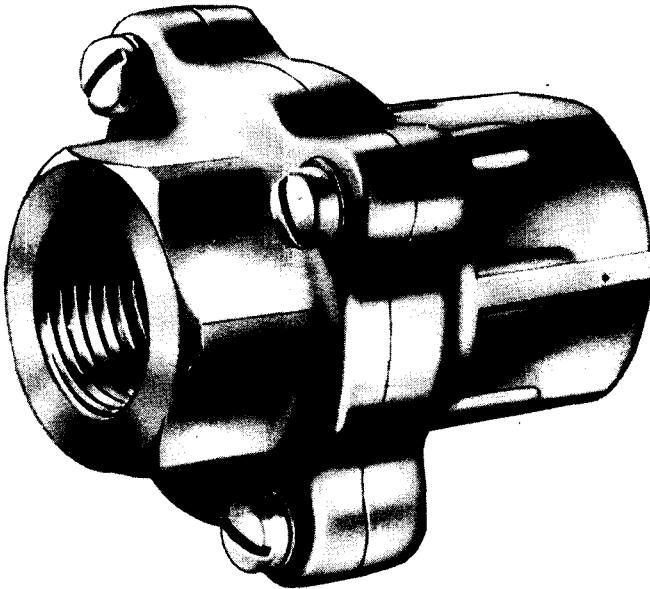
VC AND TC CHECK VALVES

Section I

DESCRIPTION, OPERATION, AND DATA

101. DESCRIPTION.

a. The VC check valve is installed on trucks in a vertical position in the vacuum line to the intake manifold. The purpose of the valve is to trap vacuum in the system at its highest point ready for brake application.



RA PD 312348

Figure 117—VC or TC Check Valve

b. The TC check valve is installed in the right-hand line of trailer brake in a horizontal position. This valve provides for automatic emergency brake application in case of accidental breakaway.

102. OPERATION.

a. **VC Check Valve.** When the vacuum on top of check valve is less than at the bottom, the unbalanced condition causes the poppet

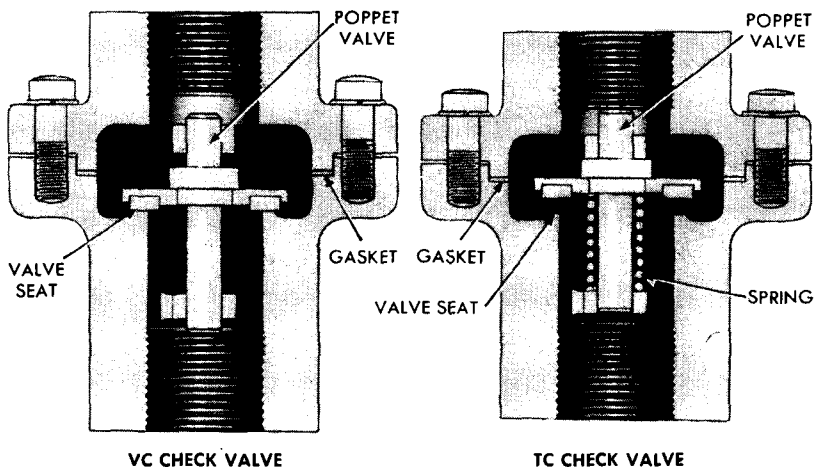
VC AND TC CHECK VALVES

valve to rest on its seat, holding the higher vacuum in the system. Rapid acceleration or stalling engine will cause valve to seat.

b. **TC Check Valve.** In case of accidental breakaway of trailer, the hoses break and air rushes into them. As air strikes poppet valve it will seat, holding vacuum in the trailer reservoir. A relay valve connected to other brake line actuates and applies the brakes.

103. IDENTIFICATION DATA.

a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.



RA PD 312349

Figure 118—Sectional View of VC or TC Check Valve

b. **Identification Data.** The following table is supplied to assist in identification of models, and determining the repair kit to be used in repair of the unit.

Bendix Number	Ordnance Number	Model Number	REPAIR KITS	
			Bendix No.	Ordnance No.
BK16448	.....	TC	370648	.....
BK21650	A303408	VC	370648	.....
BK16864	A167374	VC	373322	A303511
BK16610	A303397	VC	370648	.....
BK21649	.....	VC	370648	.....
371903	A303509	VC	370648	.....
373373	A303510	VC	370648	.....
373362	A303477	VC	370648	.....

ORDNANCE MAINTENANCE
VACUUM BRAKE SYSTEMS (BENDIX B-K)

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

104. DISASSEMBLY.

a. Remove four cap screws holding body sections together, and separate bodies. Remove gasket and poppet valve.

105. CLEANING, INSPECTION, AND REPAIR.

a. **Clean.** Remove dirt.

b. **Inspect.** If seat is corroded or pitted, polish with fine grade steel wool. Replace broken castings or parts.

c. **Repair.** Using proper repair kit for valve being repaired (par. 103) remove contents of the carton and exchange the new parts one by one with old parts. Place the old parts in carton for disposal, and to keep them from being confused with the new.

Section III

ASSEMBLY AND TEST

106. ASSEMBLY.

a. **VC Valve** (fig. 118). Drop poppet valve stem, long end first, into guide in body. Place gasket between cap and body, and install the four cap screws.

b. **TC Valve** (fig. 118). Place spring around long stem of poppet valve, and place stem in guide of body. Place gasket between cap and body, and install the four cap screws.

107. BENCH TEST.

a. **VC Valve** (fig. 118). Connect valve line to bottom port. Turn vacuum on and then off. There should be no drop in 15 seconds.

b. **TC Valve** (fig. 118). Connect vacuum line to bottom port. Hold hand over open end and turn vacuum on. Remove hand from opening suddenly and valve should seat. Turn off vacuum; there should be no drop in 15 seconds.

CHAPTER 17

AIR CLEANER (OIL-BATH TYPE)

Section I

DESCRIPTION, OPERATION, AND DATA

108. DESCRIPTION.

a. The oil-bath type air cleaner (fig. 119) is used in dusty areas. It is connected to a vacuum brake system to prevent dirt and foreign matter from entering the system. The cleaning element consists of a quantity of oil, over which air must pass, and a filter element.



RA PD 312350

Figure 119—Oil-bath Type Air Cleaner

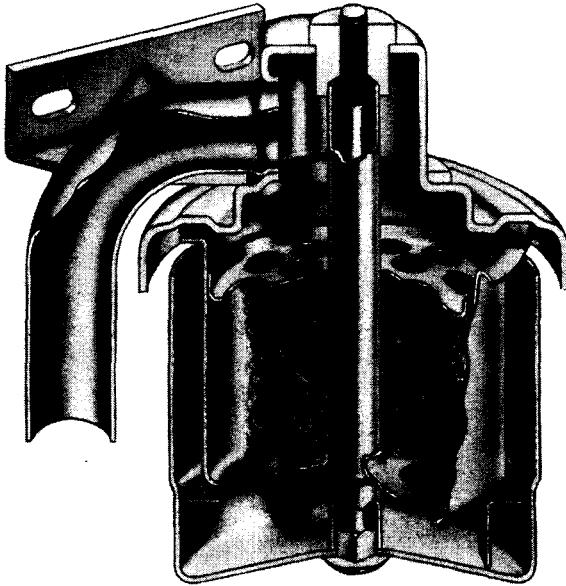
109. OPERATION.

a. Air enters under cover and over lip of lower shell, passes downward, and strikes a film of oil (fig. 120). Dirt and dust will mix with oil, allowing cleaned air to pass up through filter element to vacuum brake system.

110. IDENTIFICATION DATA.

a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to

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VACUUM BRAKE SYSTEMS (BENDIX B-K)



RA PD 312351

Figure 120—Sectional View of Oil-bath Type Air Cleaner

the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

111. DISASSEMBLY.

a. Remove bottom shell by screwing off with the hands. Pour out oil.

112. CLEANING, INSPECTION, AND REPAIR.

a. **Clean.** Clean in carburetor cleaning solution, and rinse in dry-cleaning solvent.

b. **Inspect and Repair.** Inspect for broken parts, and repair or replace as needed. **NOTE:** *Repair kit is not available.*

AIR CLEANER (OIL-BATH TYPE)

Section III

ASSEMBLY AND TEST

113. ASSEMBLY.

a. Screw shell into cleaner top. Fill to full mark with engine oil when installing on vehicle.

114. BENCH TEST.

a. Blow air through hose connection to determine if air can pass through freely.

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VACUUM BRAKE SYSTEMS (BENDIX B-K)

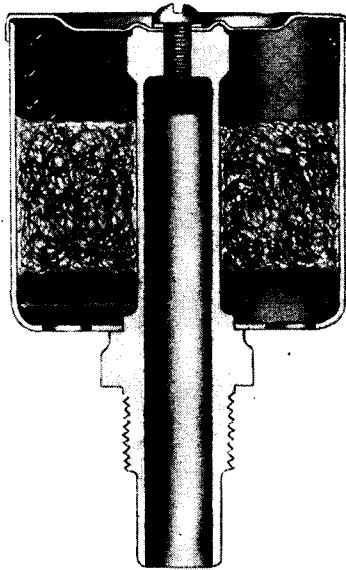
CHAPTER 18
AIR CLEANER (DRY TYPE)

Section I

DESCRIPTION, OPERATION, AND DATA

115. DESCRIPTION.

a. Air cleaners are installed in the vacuum brake system to prevent dirt and foreign matter from entering the power brake system. The cleaning element is a combination of hair and screens through which the air is drawn.



RA PD 312352

Figure 121—Sectional View of Dry-type Air Cleaner

116. OPERATION.

a. The lower port of the air cleaner is connected to the power brake system by a length of hose, or is installed on a unit by a fitting. Air enters the bottom of the cleaner, passes through a wire screen, then through a mass of curled hair, through another screen, up and into a center tube, and then to the power brake system (fig. 121).

AIR CLEANER (DRY TYPE)

117. IDENTIFICATION DATA.

a. **Identification Tags.** Identification tags showing model number (fig. 7) should be supplemented by an identification tag attached to the unit by the using arm or organization forwarding the unit for repair. Do not destroy the tag which identifies the vehicle from which the unit has been removed, as it will serve to correctly mark the rebuilt unit for replacement on a similar vehicle.

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

118. DISASSEMBLY.

- a. **Preliminary Instructions.** Clean air cleaner externally.
- b. **Disassemble Unit.** Remove the top cover plate, screens, and hair.

119. CLEANING, INSPECTION, AND REPAIR.

- a. **Clean.** Wash parts thoroughly in carburetor cleaning solution, and rinse in dry-cleaning solvent. Wash the screen and hair in gasoline, and allow them to drain.
 - b. **Inspect and Repair.** Inspect for broken parts; repair or replace as needed. NOTE: *Repair kit is not available.*
-

Section III

ASSEMBLY AND TEST

120. ASSEMBLY.

- a. Dip hair in light engine oil and let it drain. Place screens and hair in shell, and replace cover.

121. BENCH TEST.

- a. Blow air through lower port to determine if air can freely pass through hair filament.

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VACUUM BRAKE SYSTEMS (BENDIX B-K)

CHAPTER 19

VACUUM RESERVOIR

Section I

DESCRIPTION AND OPERATION

122. DESCRIPTION.

a. A vacuum reservoir is a storage tank to hold vacuum for brake applications, and serves as an emergency brake application in case of breakaway from towing vehicle.

123. OPERATION.

a. Reservoir is emptied of air while engine is running and trailer connected. In case of accidental breakaway, the check valve in system closes, holding vacuum in reservoir. Relay valve on the trailer actuates, allowing vacuum in tank to apply brakes.

Section II

CLEANING, INSPECTION, REPAIR, AND TEST

124. CLEANING, INSPECTION, AND REPAIR.

- a. **Clean.** Clean reservoir externally.
- b. **Inspect and Repair.** Inspect for breaks and repair if necessary.

125. BENCH TEST.

a. Apply vacuum to tank and turn vacuum off. No drop in vacuum should occur in 15 seconds.

CHAPTER 20

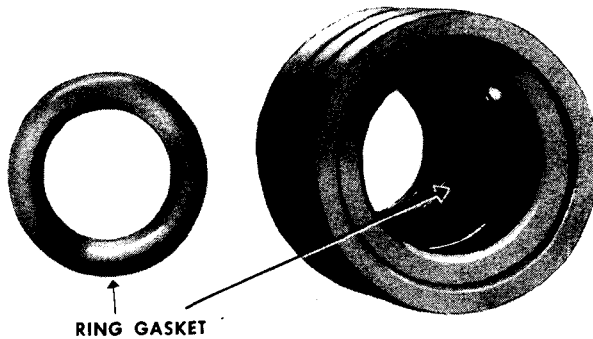
FEMALE COUPLING

Section I

DESCRIPTION AND OPERATION

126. DESCRIPTION.

a. This device is used to connect the vacuum brake system of a towing vehicle to the vacuum brake system of a trailer. It is a female receptacle to accommodate the male coupling of connecting hoses.



RA PD 312353

Figure 122—Female Coupling

127. OPERATION.

a. When outer sleeve is pushed in against spring tension, a ball bearing is allowed to fall back into a groove, allowing entrance of the male coupling. Release of sleeve brings ball bearing into groove of male coupling, locking it in place.

Section II

DISASSEMBLY, CLEANING, INSPECTION, AND REPAIR

128. DISASSEMBLY.

- a. **Preliminary Instructions.** Wash all external surfaces.
- b. **Remove Ring Gasket.** With sharp-pointed instrument, pick out rubber ring in groove of internal opening.

129. CLEANING, INSPECTION, AND REPAIR.

- a. **Clean.** Clean and wipe off all dirt.
- b. **Inspect.** Make sure sleeve works freely. Replace entire coupling if sleeve is frozen.
- c. **Repair.** With ring gasket on fingertip, slide gasket into bore until ring settles in groove at bottom of bore (fig. 122).

REFERENCES

PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes to or revisions of the publications given in this list of references and for new publications relating to materiel covered in this manual:

Introduction to ordnance catalog (explains SNL system)	ASF Cat. ORD-1, IOC
Ordnance publications for supply index (index to SNL's)	ASF Cat. ORD-2, OPSI
Index to ordnance publications (lists FM's, TM's, TC's and TB's of interest to ordnance personnel, MWO's, OPSR's, BSD, S of SR's, OSSC's and OFSB's. Includes alphabetical listing of Ordnance major items with publications pertaining thereto)	OFBS 1-1
List of publications for training (lists MR's MTP's T/BA's, T/A's, and FM's, TM's, and TR's concerning training)	FM 21-6
List of training films, film strips and film bulletins (lists TF's, FS's, and FB's by serial number and subject)	FM 21-7
Military training aids (lists graphic training aids, models, devices, and displays)	FM 21-8

STANDARD NOMENCLATURE LISTS.

Cleaning, preserving and lubrication materials, recoil fluids, special oils, and miscellaneous related items	SNL K-1
Ordnance maintenance sets	SNL N-21
Pipe and hose fittings	SNL H-6
Pipe, tubing, and hose	SNL H-7
Soldering, brazing and welding materials, gases and related items	SNL K-2
Tools, maintenance, for repair of automotive vehicles	SNL G-27
Tool sets—motor transport	SNL N-19
Tool sets, for ordnance service command automotive shops	SNL N-30

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Fundamental Principles.

Automotive brakes	TM 10-565
Military motor vehicles	AR 850-15
Precautions in handling gasoline.....	AR 850-20
The machinist	TM 10-445
Standard military motor vehicles	TM 9-2800

Maintenance and Repair.

Basic maintenance manual	TM 38-250
Cleaning, preserving, lubricating and welding materials and similar items issued by the ordnance department	TM 9-850
Fuels, lubricants, cleaners, and preservatives...	TM 9-2835
Motor vehicle inspection and preventive main- tenance services	TM 9-2810
Ordnance maintenance: Hydraulic brakes (Wagner-Lockheed)	TM 9-1827C

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Decontamination	TM 3-220
Decontamination of armored force vehicles....	FM 17-59
Defense against chemical attack	FM 21-40
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Storage and Shipment.

Ordnance storage and shipment chart, group G—Major items	OSSC-G
Registration of motor vehicles	AR 850-10
Rules governing the loading of mechanized and motorized army equipment, also major caliber guns, for the United States Army and Navy, on open top equipment published by Operations and Maintenance Department of Association of American Railroads.	
Storage of motor vehicle equipment	AR 850-18

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